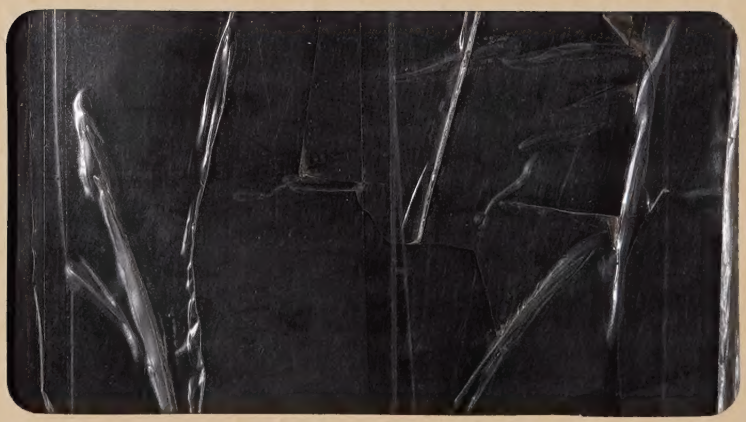
ID No. K118190
- RETURN TO -
INSTRUMENT CONTROL
SYLVANIA SES -- West

INSTRUCTION MANUAL

Type 1340
Pulse Generator

A

GENERAL RADIO



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WARRANTY

We warrant that each new instrument manufactured and sold by us is free from defects in material and workmanship, and that, properly used, it will perform in full accordance with applicable specifications for a period of two years after original shipment. Any instrument or component that is found within the two-year period not to meet these standards after examination by our factory, District Office, or authorized repair agency personnel will be repaired or, at our option, replaced without charge, except for tubes or batteries that have given normal service.

Type 1340
Pulse Generator

A

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Form 1340-0160-A
February 1969
ID-8861

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Specifications

PULSE PERIOD (PRF)

Internally Generated: 50 ns to 5 s (20 MHz to 0.2 Hz) in 8 decade ranges. Single-pulse push button on panel.

Externally Controlled: 1 Hz to 20 MHz; triggers on any waveform of >3 V pk-pk. Input resistance approx 100 kΩ. Output pulse is started by negative-going transition. Period control acts as input trigger-level control in external mode.

OUTPUT-PULSE CHARACTERISTICS

Duration: 25 ns to 2.5 s in 8 decade ranges, or square wave.

Rise and Fall Times: 5 ns ±2 ns at 5 V, 50-Ω load, and 50-Ω source resistance.

Amplitude: Positive and negative ground-based pulses available simultaneously with independent amplitude and offset control. Source current continuously adjustable to at least 0.2 A (i.e., across 50-Ω load, 10 V from high source resistance or 5 V from 50-Ω source).

Offset: Continuously adjustable source current from −20 to +20 mA.

Source Resistance: 50 Ω, or high (approx 1 kΩ) for 50-Ω loads.

Distortion: Preshoot, overshoot, ringing, etc, <0.5 V (5% of max output).

Duty Ratio: Duty ratios of over 70% can be obtained on all ranges except decreasing to approx 50% at 50-ns period in 50-to-500-ns range.

SYNCHRONIZING PULSE

Waveform: Square wave. Negative transition precedes start of output pulse by approx 35 ns; positive transition can be used for half-period pretriggering.

Amplitude: 2.5-V pk-pk positive square wave behind 500-Ω source impedance.

MODULATION AND GATING

Modulation: Period and duration are linearly controllable by an external voltage between −0.5 and −5.0 V. Amplitude of the positive-pulse output is linearly controllable by an external voltage of 0 to +5 V, the negative-pulse output by 0 to −5 V. Period and duration are modulatable over the decade range set by range switches; amplitude can be modulated over its full range. Amplitude modulation can be used for noncoherent gating of output pulse.

Gating: An impedance of ≤600 Ω to ground inhibits output; +4 to +8 V allows normal output; 1340's can be used to gate 1340's.

GENERAL

Power Required: 100 to 125 or 200 to 250 V, 50 to 400 Hz, 30 W.

Accessories Supplied: Spare fuses, power cord.

Accessories Available: GR874® coaxial components, attenuators, terminations, tees, etc.

Mounting: Convertible-Bench Cabinet.

Dimensions (width × height × depth): Bench 8½ × 5⅝ × 13 in. (220 × 145 × 330 mm); rack, 19 × 5¼ × 11¼ in. (485 × 135 × 290 mm).

Weight: Net, 9¼ lb (4.2 kg); shipping, 13 lb (6.0 kg).

Catalog Number	*Description*
1340-9700	Bench Mount
1340-9701	Rack Mount

See *General Radio Experimenter*, November-December 1968.

NOTE: This instrument is equipped with our new snap-on knob for added convenience and safety. Refer to the Service Section for details.

Condensed Operating Instructions

a. Connect the desired instrument(s) to the +PULSE and -PULSE connectors and to the SYNC OUTPUT connector (if a synchronizing pulse is required).

b. Set the PULSE PERIOD/FREQUENCY and PULSE DURATION controls, to obtain the desired pulse period/frequency and pulse-duration output. If single-pulse operation is desired, set the PULSE PERIOD/FREQUENCY ring dial-control to SINGLE PULSE and the PULSE DURATION controls to the desired pulse duration. A single pulse is produced when the SINGLE PULSE pushbutton is pressed, after the instrument is energized.

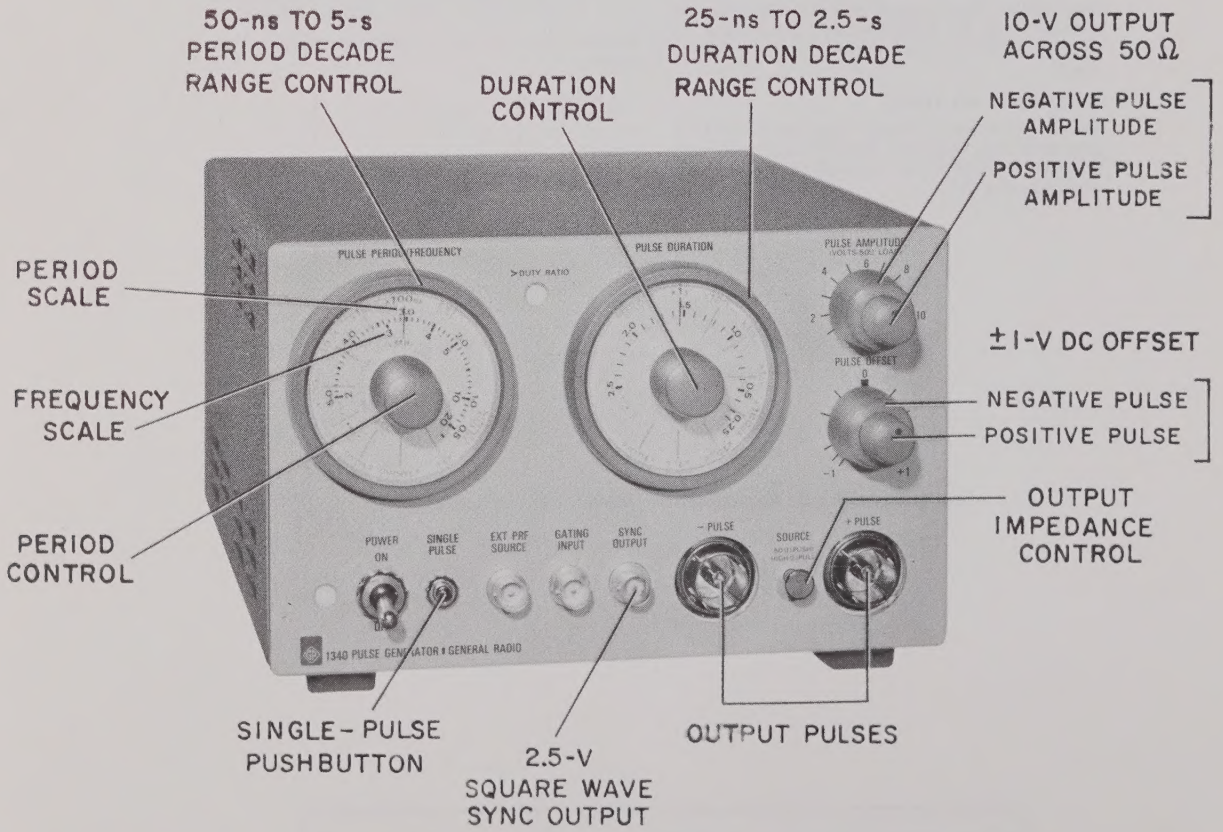
c. Push in the SOURCE control if a 50-Ω output impedance is desired, or pull it out if a high (≈100 kΩ) output impedance is desired.

d. If an external source is desired for controlling the output pulse-repetition frequency (prf), connect the external source (not energized) to the EXT PRF connector; adjust the source's output for a 1-Hz to 20-MHz, 3-V to 12-V pk-pk output, as desired; and set the PULSE PERIOD/FREQUENCY ring dial-control to EXT PRF.

e. If gating of the output is desired, connect a gating switch that provides an impedance equal to or less than 600Ω to ground for the time it is desired to inhibit the output, and an open circuit for the time an output is desired, or use a source with an impedance less than 600Ω and with open-circuit voltages of 4-V or more (to allow an output) and 0-V (to inhibit the output), such as another 1340.

f. Adjust the PULSE AMPLITUDE and PULSE OFFSET controls for the desired output.

g. Set the POWER switch to ON and observe that the pilot lamp on the front-panel lights; turn on all the input- and output-connected instruments.



Introduction–Section 1

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1.1 PURPOSE

The GR 1340 Pulse Generator (Figure 1-1) is a general-purpose pulse source that provides wide ranges of repetition frequency and duration, high output, and many performance and convenience features not usually found in a single pulse-generator.

The instrument provides eight decade ranges of pulse periods/frequencies (50 ns to 5 s/20 MHz to 0.2 Hz) and eight decade ranges of pulse duration (25 ns to 2.5 s). Provisions are made for the application of external signals, if desired, to control the pulse repetition frequency (prf); to gate the output; and to modulate the amplitude, period, and duration of the pulses.

Both positive and negative ground-based pulses of up to 10 V and offsets to ± 1 V are produced simultaneously, and their amplitude and offsets can be independently set with front-panel controls. Also on the front panel are calibrated controls for adjusting pulse amplitude, pulse period/frequency, and pulse duration. Control is also provided for output impedance, single pulsing, input threshold for external prf sources, and for producing square waves.

Many features of the GR 1340 have been incorporated to aid in the testing of integrated circuits. Its 20-MHz operation, adjustable offset, square-wave output, and ability to operate at the standard 5-V logic level with a 50-Ω source impedance are especially valuable in integrated-circuit testing. The ability to linearly modulate the pulse amplitude, duration, and period makes the 1340 useful in automatic and semiautomatic measurements..

1.2 DESCRIPTION.

The 1340 is assembled in a metal cabinet ready for bench use. A Rack Adaptor Set (P/N 0480-9723) is available for installation of the instrument in an Electronic Instrument Association (EIA) standard 19-inch wide relay rack. Most of the instrument's circuit components, including three calibration adjustments, are on one etched-circuit board in the instrument. Two line-voltage fuses are mounted in extraction-post holders inside the cabinet at the rear. These components, adjustments, and fuses are easily accessible when the retaining screws at the rear are loosened, and the chassis is removed from the cabinet.

The instrument has its own power supply and can be powered by 100- to 125-V or 200- to 250-V, 50- to 400-Hz line voltages. A switch on the rear panel allows selection of the desired voltage. The instrument has an extendable bail between the two front feet, which when pulled down, will allow the instrument to be set in a tilted position for easy viewing of the front panel.

Holes are provided in the rear panel for remounting the front-panel input and output connectors, if it is desired to rack-mount the instrument, making signal connections at the rear of the instrument.

1.3 CONTROLS AND CONNECTORS AND INDICATORS.

Figure 1-1 shows the front-panel controls, connectors, and indicators. Table 1-1 contains a description of them. Table 1-2 contains a description of the rear-panel connectors.

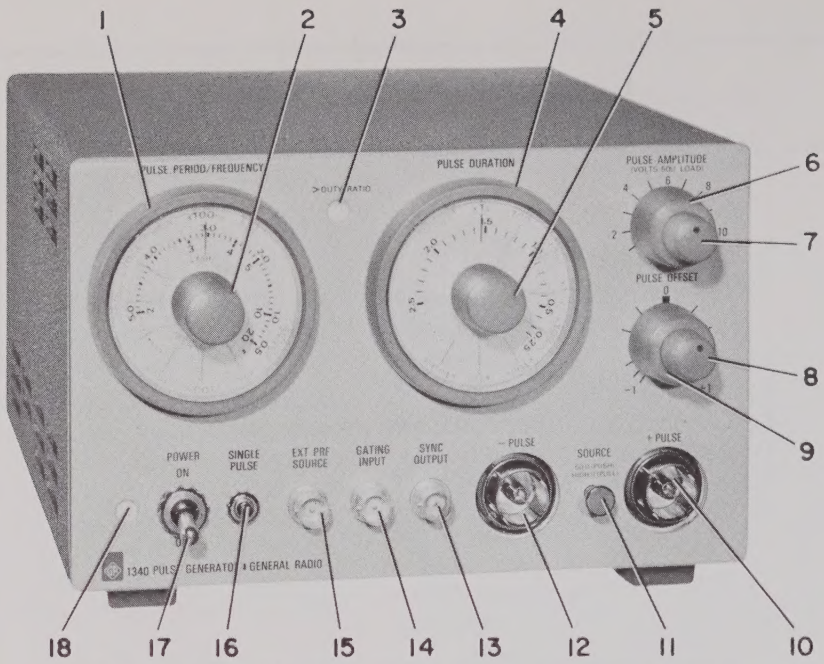

Figure 1-1. Type 1340 Pulse Generator front-panel controls and connectors.

Table 1-1
FRONT-PANEL CONTROLS, CONNECTORS, AND INDICATORS

Fig. 1-1 Ref. No.	Name	Type	Function
	PULSE PERIOD/FREQUENCY		
1	Ring dial	10-position rotary switch	Selects eight decade ranges of pulse period/frequency (50 ns - 5 s/20 MHz - 0.2 Hz), and in conjunction with the knob dial, establishes the output-pulse period/frequency. When set to SINGLE PULSE, and the SINGLE PULSE pushbutton is pressed, a single pulse (of a duration established by the PULSE DURATION controls) occurs. When set to EXT PRF, an external source can be applied to the EXT PRF SOURCE jack, establishing the pulse period/frequency. The selected position is indicated in red at the top of the switch.
2	Knob dial	Dial with graduations from 0.5-5 for pulse period and 2-20 for corresponding frequencies	In conjunction with the ring dial, establishes the pulse period and corresponding frequency. The setting of the knob dial is multiplied by the number on the ring dial, determining the output pulse period/frequency. Acts as a trigger-level control when the ring dial is set to EXT PRF and an external PRF source is applied to the instrument.
3	> DUTY RATIO	Indicator lamp	Flashes when the duty ratio exceeds limits.
	PULSE DURATION		
4	Ring dial	9-position rotary switch	Selects eight decade ranges of pulse duration (25 ns - 2.5 s), and in conjunction with the knob dial, establishes the pulse duration. When set to SQUARE WAVE, a squarewave is produced (50% duty ratio). The selected position is indicated in red at the top of the switch.

Table 1-1 Cont.
FRONT-PANEL CONTROLS, CONNECTORS, AND INDICATORS

Fig. 1-1 Ref. No.	Name	Type	Function
5	Knob dial	Dial with graduations from 0.25 - 2.5	In conjunction with the ring dial, establishes the pulse duration. The setting of the ring dial is multiplied by the number on the knob dial, determining the output-pulse duration.
	PULSE AMPLITUDE		
6	Large knob	Continuously adjustable rotary control	Adjusts the negative output-pulse amplitude from 0-10 V if a high source resistance is selected with the SOURCE control for a 50-Ω load, and from 0-5 V if a 50-Ω source resistance is selected for a 50-Ω load.
7	Small knob with red marking	Continuously adjustable rotary control	Adjusts the positive output-pulse amplitude the same as large knob adjusts the negative pulse (above).
	PULSE OFFSET		
8	Large Knob	Continuously adjustable rotary control	Offsets the negative output-pulse amplitude ±0.5 V around 0 V when a 50-Ω source resistance is used with a 50-Ω load or ±1 V when a high source resistance is used with a 50-Ω load.
9	Small knob with red marking	Continuously adjustable rotary control	Offsets the positive output-pulse amplitude the same as the large knob adjusts the negative pulse (above).
10	+PULSE	GR Type 874-PRLA connector	Positive output-pulse connection.
11	SOURCE	Push-pull control	When pushed in, establishes a 50-Ω source resistance. When pulled out, establishes a high source resistance for 50-Ω loads (approximately 1 kΩ).
12	-PULSE	GR Type 874-PRLA connector	Negative output-pulse connection.
13	SYNC OUTPUT	BNC coaxial jack	Synchronizing-pulse output connection.
14	GATING INPUT	BNC coaxial jack	Gating-signal input connection.
15	EXT PRF SOURCE	BNC coaxial jack	Ac-coupled input connection for an external PRF source.
16	SINGLE PULSE	Pushbutton switch	When pressed, and the PULSE PERIOD/FREQUENCY switch is set to SINGLE PULSE, provides a single output-pulse of a duration determined by the setting of the PULSE DURATION switch.
17	POWER ON-OFF	Toggle switch DPDT	Energizes the instrument.
18		Pilot lamp	Lights when the instrument is energized.

Table 1-2

REAR-PANEL CONTROLS AND CONNECTORS

Name	Type	Function
- - -	3-terminal power-plug	Line-voltage connection. A long ground-pin connects directly to the metal case of the instrument.
50-400 Hz, 100-125, 200-250 NOTE Two line-voltage slo-blo fuses are in extraction-post fuse holders inside the dust cover, behind the rear panel. The 0.4-A fuse is for 100-125 V and the 0.2-A fuse is for 200-250 V. No fuse changes are required when changing line voltages.	Two-position screwdriver-operated slide switch	Selects the proper range of line voltage.

1.4 ACCESSORIES SUPPLIED.

A power cord (P/N 4200-9622) and two fuses (Bussman Mfg. Co., MDL, 0.4 A and MDL, 0.2 A) are supplied with the instrument.

1.5 ACCESSORIES AVAILABLE.

Table 1-3 lists the accessories and related equipment available.

1.6 PATCH CORDS AND ADAPTORS.

The front-panel +PULSE and -PULSE connectors are GR Type 874-PRLA for ensuring low VSWR and stable electrical performance. These connectors are neither male or female and with adaptors can conveniently provide any popular connection desired. Other input-output connectors are standard BNC jacks. Patch cords (Table 2-2) and adaptors (refer to the appendix at the rear of the book) are available to convert the terminals for use with most commercial and military connectors.

For the user who wishes to mate the Pulse Generator to components fitted with coaxial connectors of other leading coaxial series, GR874 adaptors are available to convert the +PULSE and -PULSE connectors to the desired type of plug or jack. Refer to the Appendix at the rear of this manual for the GR adaptors and other coaxial components that are available.

Table 1-3

ACCESSORIES AND RELATED EQUIPMENT AVAILABLE

Name	GR Type or Part No.	Function
Rack Adaptor Set	P/N 0480-9723	Rack-mount instrument.
Oscillator	Type 1310	Sine-wave signal source for sine-wave modulation of the 1340 output.
*Audio-Frequency Microvolter	Type 1346	Precision metered attenuator (dc to 100 kHz).
Modulator Pulse Generator	Type 1395	Pulse source that provides a wide variety of pulses that can be used for modulating the 1340 pulse period/frequency, duration, and amplitude.
Pulse Amplifier	Type 1397	Pulse amplifier for a generator supplying negative input pulses. Output amplitude: 1.2 A pk-pk, max (60 V into 50 Ω); 1 A pk-pk with 10% duty ratio. Positive or negative polarity, ground-based, direct coupled.

*Panel size suitable for rack-mounting side-by-side with the 1340.

Installation—Section 2

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2.1 INSTRUMENT LOCATION

The 1340 Pulse Generator can be operated in bench and rack-mount configurations. Locate the instrument so that vent holes on the sides are unrestricted. Although unrestricted airflow is desirable, no damage will result to the instrument if the air vents are obstructed.

2.2 DIMENSIONS.

Figure 2-1 shows the overall dimensions of the 1340 in bench- and rack-mount configurations.

2.3 ELECTRICAL CONNECTIONS.

The 1340 operates on 50- to 400-Hz line voltages of either 100 to 125 V or 200 to 250 V, depending on the setting of the line-voltage switch on the rear panel.

Set the line-voltage switch for the appropriate line-voltage provided, using a narrow-blade screwdriver, and connect the 3-wire power cord to the line and 3-terminal male connector on the rear panel.

2.4 BENCH MOUNTING.

To set the instrument in a tilted position for easy viewing, pull the bail between the front feet down as far as possible.

2.5 RACK MOUNTING.

2.5.1 Single Instrument.

With the Rack Adaptor Set, P/N 0480-9723, the 1340 portable bench model can be converted for use in an EIA standard 19-in. relay rack. Table 2-1 lists the parts included in the Rack Adaptor Set.

Mount the instrument as follows (see Figure 2-2):

a. Loosen the two captive 10/32 screws in the rear of the cabinet until the chassis is free; slide the chassis forward out of the cabinet.

b. Remove the four rubber feet from the cabinet. Simply push out the two rear feet. Spread the bail (A, Figure 2-2) slightly and the two front feet (B) and the bail will drop out. Be sure to save all parts as they are removed for possible reconversion of the instrument to bench mounting.

c. Pierce and push out the plugs from the four bosses (C) on the inner sides of the cabinet, near the front.

d. Press the subpanel (D) into the blank panel (E) to form a support liner for the latter.

e. Attach the short flange of the blank panel to the front of the cabinet (on either side of the cabinet, as desired) using two 5/16-in. screws (F). Note that the screws enter in opposite directions—one from inside the cabinet and one from the flange side, as shown.

f. Pierce and push out the plug in the rear boss (G) *on the side toward the blank panel only*, as shown.

g. Attach one end of the support bracket (H) to the lower rear boss. The bracket must be placed so that the screw passes through a clearance hole into a tapped hole.

h. Attach the other end of the support bracket to the lower rear hole in the wide flange, as shown using a 5/16-in. screw (K).

i. Attach one Rack-Adaptor Assembly (handle) to the side of the cabinet opposite the blank panel, using two 5/16-in. screws (L). Again note that the screws enter in opposite directions, one from inside the cabinet and one from outside. Use the upper and lower holes in the assembly.

j. Attach the other Rack-Adaptor Assembly (handle) to the wide flange on liner (D) and the flange on the blank panel (E). Use two 5/16-in. screws (M) through the two flange holes nearest the panel and through the upper and lower holes in the handle. Again, the screws enter in the opposite directions.

k. Install the instrument in the cabinet and lock it in place with the two captive screws in the rear that were loosened in step a.

l. Place a straight edge across both the instrument panel and the blank panel. Loosen the screw (J) *through the slot* in the support bracket (H). Exert a slight pressure on the blank panel (E) so that it forms a straight line with the instrument panel, and tighten the screw (J) in the bracket to lock the panels in this position.

m. Slide the entire assembly into the relay rack and lock it in place with the four 9/16-in. screws (N) with captive nylon cup washers. Use two screws on each side and tighten them by inserting a screwdriver through the holes (P) in the handles.

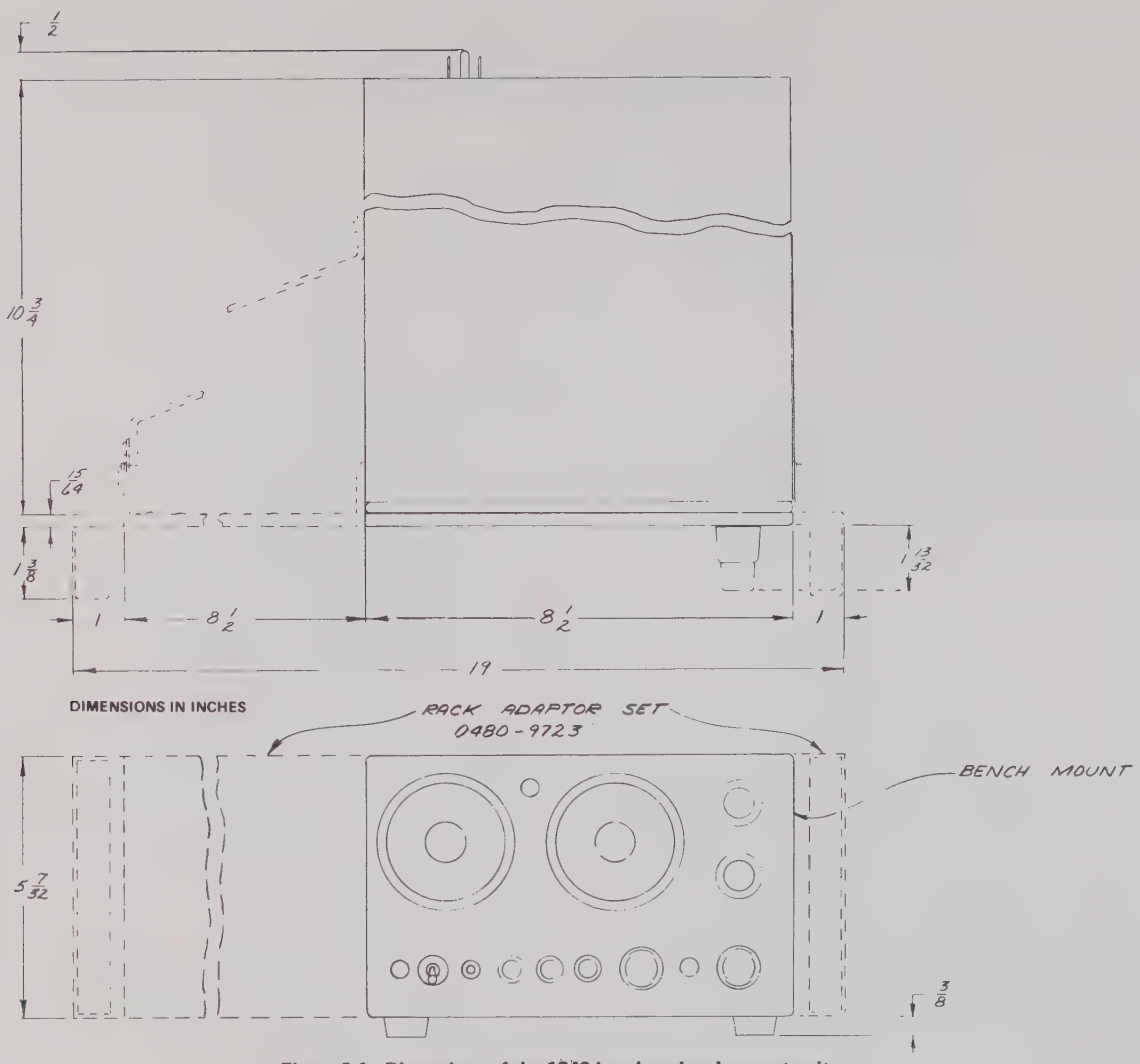


Figure 2-1. Dimensions of the 1340 bench and rack-mount units.

2.5.2 Reconversion to Bench Mount.

a. To reconvert the instrument for bench use, reverse the procedures of paragraph 2.5.1 first removing the entire assembly of instrument, cabinet, and blank panel from the rack.

b. Remove:

1. Chassis from the cabinet
2. Support bracket (H) from the cabinet
3. Blank panel (with handle attached) from one side of the cabinet.
4. Rack-Adaptor Assembly (handle) from the other side of the cabinet.

c. Push the two rear feet into the cabinet, and slide the bail (A) and two front feet (B) into place. Install the instrument in its cabinet and lock it in place with the two captive screws through the rear panel.

2.5.3 Rack-Mounting Two Instruments.

Two instruments of the same panel size (such as two 1340's or instruments indicated in Table 1-3) can be mounted side-by-side in a standard 19-in. relay rack. Use the procedure of paragraph 2.5.1, substituting the second instrument for the blank panel. Do not use the support bracket (H, Figure 2-2), but insert three screws through the bosses in the adjacent sides of the cabinet, two near the front (C) and one near the rear (G). The four feet and the bail must, of course, be removed from each cabinet. Use the four screws (N) with nylon washers to lock the instruments in the rack. The required hardware is:

1. Three screws, BH 10-32, 5/16-in., P/N 7080-0800.
2. Four screws, BH 10-32, 9/16-in., with nylon washers, P/N 7270-6310.

Table 2-1

PARTS INCLUDED IN THE RACK ADAPTOR SET,
P/N 0480-9723 (see Figure 2-2)

Fig. 2-2 Ref.	No. Used	Item	GR Part No.
E	1	Blank Panel	0480-8933
D	1	Sub-Panel	0480-8952
—	2	Rack Adaptor Assembly	0480-4903
H	1	Support Bracket	0480-8524
—	1	Hardware Set includes:	0480-3080
F,J,K,L,M, N		8 Screws, BH 10-32,5/16"	7080-0800
		4 Screws, BH 10-32. 9/16" w. nylon cup washers	7270-6310

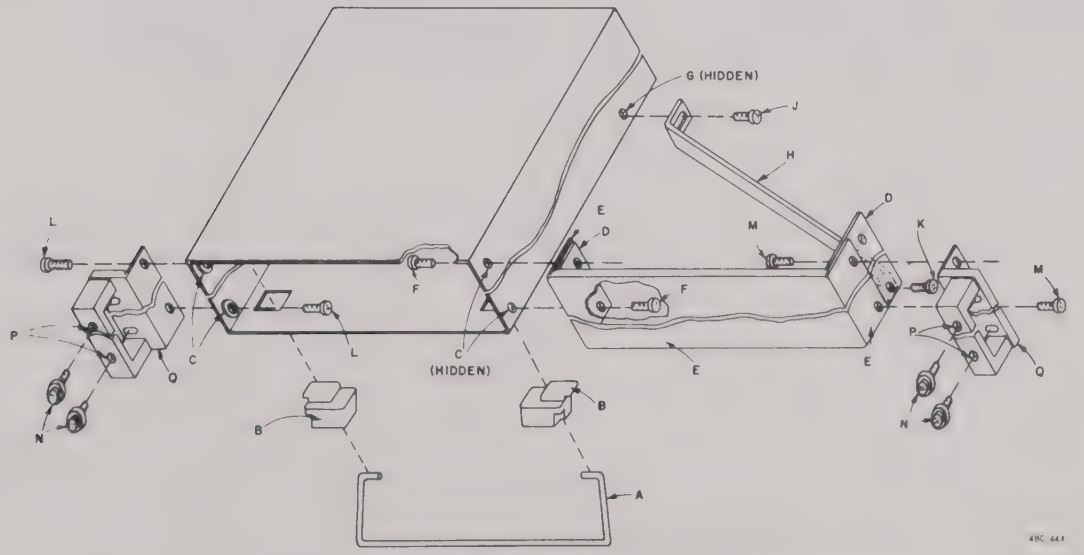
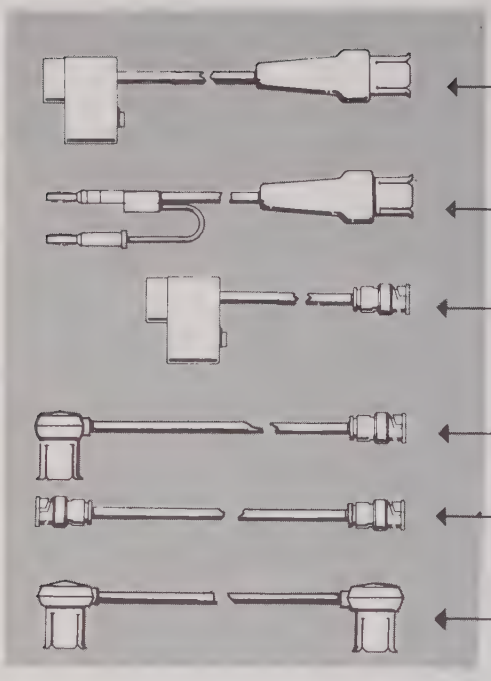


Figure 2-2. Method of mounting the 1340 and a blank panel in a relay rack.

Table 2-2
AVAILABLE INTERCONNECTION ACCESSORIES



874-R34	Coaxial patch cord, double plug to GR874, 36" long	0874-9692
874-R33	Coaxial patch cord, two plugs to GR874, 36" long	0874-9690
776-A	Patch cord, shielded double plug to BNC plug, 36" long	0776-9701
776-B	Patch cord, GR874 (right-angle) to BNC plug, 36" long	0776-9702
776-C	Patch cord, BNC plug to BNC plug, 36" long	0776-9703
776-D	GR874 to GR874, both right-angle, 36" long	0776-9704

Operation–Section 3

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3.1 GENERAL.

This section contains instructions on how to operate the 1340 Pulse Generator in all its modes of operation, contains a listing of definitions of terms used in these instructions, and explains various features of the instrument pertaining to its operation.

3.2 DEFINITIONS OF TERMS.

The following are defintions of terms used in these instructions:

Term	Definition
Pulse repetition frequency (prf)	The frequency at which pulses are produced.
Period	The reciprocal of prf (in time units).
Duration	The time interval the positive pulse is at its positive level, or negative pulse is at its negative level, measured from 50% of amplitude level.
Output Pulse	The principal output of the instrument, available at the PULSE terminals.
Synchronizing Pulse	Positive 2.5-V pk-pk square wave, whose negative transition precedes the start of the output pulse by approximately 35 ns and positive transition occurs one-half period later. Refer to paragraph 3.11 for details.
Internal Operation	The mode in which the period/frequency is produced by the 1340 itself and controlled with the PULSE PERIOD/FREQUENCY controls on the front panel.
External Operation	The mode in which pulse period/frequency is produced by an external source, applied to the EXT PRF connector on the front panel.
Duty Ratio	The ratio of pulse duration to the period established with the PULSE PERIOD/FREQUENCY and PULSE DURATION controls. Duty ratio in percent $= \frac{\text{Duration}}{\text{Period}} \times 100.$

3.3 POWER CONNECTION.

To power the instrument:

a. Check that the POWER switch is set to OFF.

b. Set the line-voltage slide switch on the rear panel to the position corresponding to the line voltage. Use a narrow-blade screwdriver to slide the switch.

c. Connect the supplied power cord to the power source and to the power connector on the rear panel.

3.4 NORMAL INTERNAL OPERATION.

Perform the following steps for normal internal operation:

a. Connect the applicable instrument(s) and/or devices to either the -PULSE and/or +PULSE connectors.

GR874 patch cords, coaxial components, attenuators, terminations, tees, etc., are recommended for the connections. GR adaptors to other connectors are available. Refer to paragraph 3.9 for other details concerning connections.

b. If it is desired to synchronize the instrument(s) or devices with the 1340's output, connect the synchronization or trigger connections to the front-panel SYNC connector. Refer to paragraph 3.11 for details concerning synchronization.

c. If it is desired to operate with a 5-V maximum output-pulse amplitude across a 50Ω load, push in the SOURCE control. If a 10-V maximum pulse-amplitude is desired, pull the SOURCE control out. Refer to paragraph 3.9, if necessary, for details concerning external-load considerations.

d. Set the PULSE/FREQUENCY ring and knob dial-controls to obtain the desired pulse period or frequency. The two concentric dial scales allow setting either the period or the corresponding frequency.

e. Set the PULSE DURATION ring and knob dial-controls to obtain the desired pulse duration.

f. Set the POWER switch to ON; the pilot lamp should light. The >DUTY RATIO lamp will flash if the duty ratio limit is being exceeded. Refer to paragraph 3.8 for details concerning duty-ratio limits.

g. Adjust the PULSE OFFSET control(s) to obtain the desired pulse-level offset. Refer to paragraph 3.10, if necessary, for details concerning offset control.

NOTE

Because the output-pulse level is electronically controlled, distortion is more predominant at lower output levels. If very low distortion is desired at lower levels, connect an attenuator to the output and operate the 1340 at a high output level. A GR Type 874-G Attenuator is recommended.

3.5 SINGLE-PULSE OPERATION.

To provide single pulses:

a. Set the PULSE PERIOD/FREQUENCY ring dial-control to SINGLE PULSE and the PULSE DURATION controls to the desired pulse duration.

b. Press the SINGLE PULSE pushbutton momentarily; a single pulse of a duration determined by the PULSE DURATION controls will occur.

3.6 EXTERNAL PRF OPERATION.

The 1340 prf can be controlled externally by a 1-Hz to 20-MHz signal greater than 3 V pk-pk. The EXT PRF SOURCE connection is ac-coupled and has an input resistance of approximately 100 kΩ. The output pulse is triggered by the negative-going transition of the prf source signal; the knob dial-control of the 1340's PULSE PERIOD/FREQUENCY controls acts as an input-trigger control.

To operate the instrument in this mode, perform the following steps:

a. Perform steps a through c in paragraph 3.4.

b. Set the PULSE PERIOD/FREQUENCY ring dial-control to EXT PRF and the PULSE DURATION controls to the desired pulse duration.

c. Connect the external prf source to the front-panel EXT PRF connector and adjust the source for the desired prf and signal level. A 3.0-V to 12-V pk-pk signal is desirable.

d. Adjust the PULSE AMPLITUDE controls for the desired output and set the POWER switch to ON; the pilot lamp should light.

e. Adjust the PULSE PERIOD/FREQUENCY knob dial-control to trigger the instrument; the > DUTY RATIO lamp will flash if the duty ratio is exceeded. Refer to paragraph 3.8 for details concerning duty-ratio limits.

3.7 SQUARE-WAVE OPERATION.

To produce a square-wave output, set the PULSE DURATION ring dial-control to SQUARE-WAVE. The 1340 will automatically produce a square-wave output with approximately a 50% duty ratio. The PULSE DURATION knob control is inoperative in this mode of operation.

3.8 DUTY RATIO.

The duty ratio obtainable with the 1340 depends on the particular combination of period range and duration range selected. The duty ratio can be between the limits of 70% and 95%, except at 20 MHz where the duty ratio is approximately 50%. When the > DUTY RATIO lamp is flashing, the limit is exceeded; therefore, the period should by increased and/or the duration decreased. No instrument damage will result, however, from exceeding the duty-ratio limits.

Under some conditions, when just slightly exceeding the limits, small amounts of pulse pairing may occur, and the > DUTY RATIO lamp will not flash. Since this condition exists when the lamp is on the verge of flashing, the condition can be easily detected without an oscilloscope by slightly increasing the duty ratio from the desired setting and observing if the lamp flashes, then returning the controls to the desired setting.

3.9 OUTPUT-LOAD CONSIDERATIONS.

The 1340's output circuit has a source equivalent to a pulsed variable-current source of from zero to over 0.2 A in amplitude. In addition, 20 mA of offset current can be produced. Figure 3-1 shows the equivalent output impedance circuit.

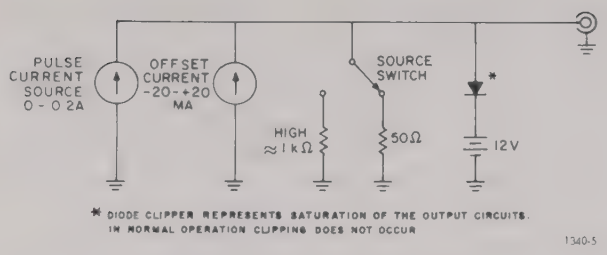
PULSE CURRENT SOURCE 0 - 0.2A
OFFSET CURRENT -20 - +20 MA
SOURCE SWITCH
HIGH ≈1kΩ
50Ω
12V
* DIODE CLIPPER REPRESENTS SATURATION OF THE OUTPUT CIRCUITS. IN NORMAL OPERATION CLIPPING DOES NOT OCCUR
1340-5

Figure 3-1. Pulse Generator equivalent output impedance circuit.

The voltage at the output is, of course, the product of the total equivalent resistance, including source resistance and load, times the output current. To keep the output circuits from saturating and to avoid the resulting waveform distortion, the output voltage must be equal to or less than 10 V. If the SOURCE switch is pulled out (HIGH Ω position) and the output current is 0.2 A, the external load must be 50 Ω, or less, to avoid saturation. A lower output current allows a larger load resistance; however, the waveshape will deteriorate.

The voltage indicated by the PULSE AMPLITUDE controls is the approximate output voltage for a high internal impedance (HIGH Ω) and a 50-Ω load. When the SOURCE knob is pushed in, an internal 50 Ω is placed across the equivalent current source. In this mode any external load resistance can be applied; the equivalent source resistance is 50 Ω and the source voltage is adjustable from zero to 10 V. With a 50-Ω load and 50-Ω source resistance, the maximum output is 5 V, since:

$$E_{OUT\ (Actual)} = E_{SOURCE} \frac{R_{LOAD}}{R_{SOURCE} + R_{LOAD}}$$

Thus, 50-Ω cable should be used for output interconnections. To preserve the output waveshape, either or both the source and the load must be 50 Ω.

The output can be applied into a short circuit without damaging the instrument.

3.10 PULSE OFFSET.

The output pulses can be independently offset ± 1 V; that is, the base line can be shifted ±1 V from the 0-V level, as shown in Figure 3-2.

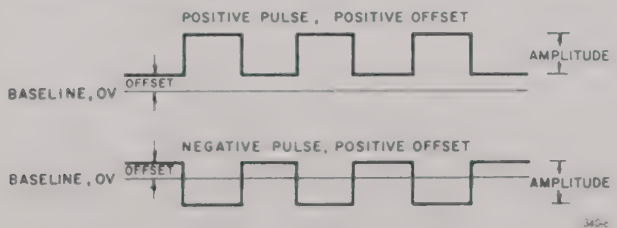

Figure 3-2. Examples of pulse-offset control.

Since it is necessary at times to set the offset to zero, a 15° "dead" zone is provided in offset control, as denoted on the 0 position of the PULSE OFFSET control.

When a 50-Ω source impedance is used with a 50-Ω load, the offset control provides a ± 0.5-V range.

3.11 SYNCHRONIZATION.

The output synchronizing waveform is a positive 2.5-V square wave (equal "on" and "off" times) behind 500 Ω, whose negative transition precedes the start of the output pulse by approximately 35 ns. Since the positive excursion occurs one-half period after the negative transition, the positive excursion can be used for half-period pretriggering. The square wave has a dc level independent of frequency, so that the signal can be ac-coupled to trigger circuits; there will be no signal level shift with frequency. Figure 3-3 illustrates the synchronizing signal. This signal can be used for synchronizing other instruments or devices with the output of the generator.

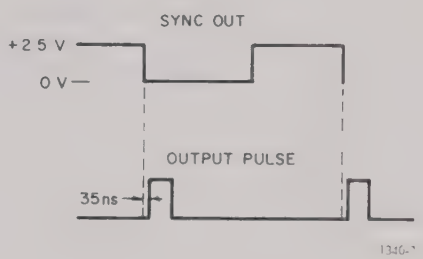

Figure 3-3. Synchronizing pulse.

3.12 GATING.

The output of the 1340 can be gated during normal internal- or external-prf operation. The gating can be performed by applying a switch closure to ground, or equivalent, at the GATING INPUT connector to inhibit the period generator circuit in the instrument, thus providing phase-coherent gating of the output pulses. An impedance of equal or less than 600 Ω to ground inhibits the output; an open circuit allows a normal output. A source with an impedance less than 600 Ω and with open-circuit voltages of 4 V or more (to allow an output) and 0 V (to inhibit the output) can be used for gating. Another 1340 is ideally suited for providing gating signals. Figure 3-4 illustrates the gating.

The pulse output is delayed by approximately one-half period from application of the gating-signal command (negative-going transition). If the inhibiting signal occurs during the output pulse, the pulse is not chopped, but allowed to pass. Thus, the start of the output is gated, not the output itself, i.e., the oscillator is gated.

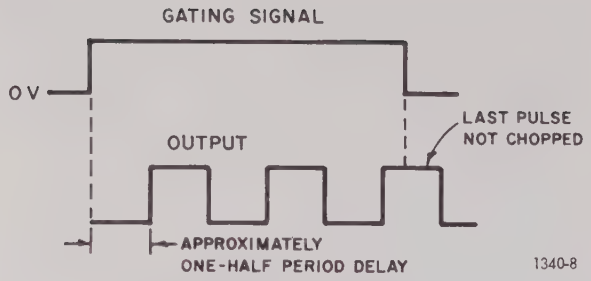

Figure 3-4. Gating waveforms.

3.13 OUTPUT MODULATION.

3.13.1 General.

The pulse period and pulse duration can be linearly controlled by the application of an external voltage between approximately -0.5 V and approximately -5.0 V. The amplitude of the positive output-pulse can be modulated by an external voltage between 0 and approximately +5.0 V, and the negative output-pulse can be modulated by a voltage from 0 to approximately -5.0 V.

The period and duration are modulatable over the decade range set by the front-panel range switches. The pulse amplitude can be modulated over its full 10-V range. Noncoherent gating of the output pulse can be obtained with pulse-amplitude modulation.

A GR 1310 Oscillator or GR 1395 Modulator Pulse Generator is ideally suited for providing modulation signals.

3.13.2 Connections.

Wire-link connections (see Figure 5-6) for applying the modulating signals are on the etched-circuit-board assembly inside the cabinet. These connections are labeled DURATION, PERIOD, +AMPL, AND -AMPL. The connections are accessible; loosen the retaining screws at the rear of the instrument and remove the cabinet. A grommetted hole is provided at the rear of the cabinet for signal connections when the instrument is fully assembled.

3.13.3 Methods of Connection.

When applying a dc modulating signal, the wire link may be disconnected. This disconnects the particular front-panel control from the circuitry, allowing application of the modulating signal to the circuitry.

To dc couple the modulating signal to the wire-link connection, cut the link, as shown in Figure 3-5, and apply the signal to the side of the link with the white circle around it. The externally applied dc-coupled modulating signal replaces the dc voltage provided by the PULSE PERIOD/FREQUENCY, DURATION, or PULSE AMPLITUDE control. (Refer to the modulation curves, paragraphs 3.13.4 and 3.13.5.)

NOTE

Early production instruments have removable links; cutting is not required.

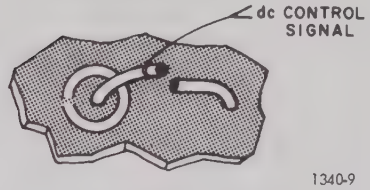

Figure 3-5. Connection for external dc control.

The modulating signal can be ac-coupled to the wire links by connecting a 1-μF capacitor between the modulating-signal source and the link, as shown in Figure 3-6. The instrument's controls establish the dc level in this type of operation.

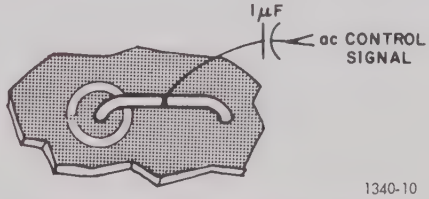

Figure 3-6. Connection for external ac control.

3.13.4 Period and Duration.

Figure 3-7 illustrates the modulation characteristic for pulse period and duration. The curve is a nominal one since there may be small variations from instrument-to-instrument. As the modulating voltage changes from -0.5 V to -5 V, the pulse period or duration increases. For example, if a voltage sweep from -0.5 V to -5 V, that drops back to -0.5 V and then repeats, is applied to the particular wire link, the pulse period or duration steadily increases from the lowest limits obtainable with the controls, and then repeats.

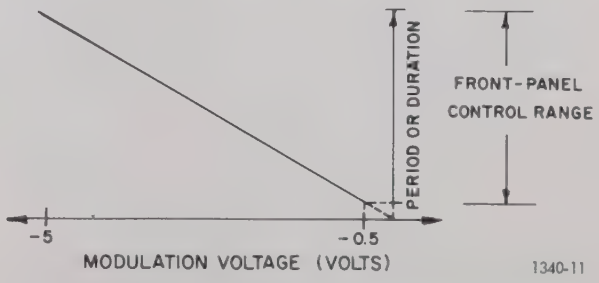

Figure 3-7. Nominal characteristic of pulse period and duration modulation.

3.13.5 Pulse Amplitude.

Figure 3-8 illustrates the nominal pulse amplitude-modulation characteristic for positive output-pulses, and Figure 3-9 illustrates the characteristic for negative output-pulses.

In Figure 3-8, which shows modulation control voltage versus positive output-pulse amplitude, it is seen that any positive voltage between 0 and 5 V will cause an output pulse to be of an amplitude proportional to the amount of voltage applied. If, for example, a varying voltage between 0 V and +5 V is applied to the + AMPL wire link, the amplitude of the positive output-pulse(s) will vary from 0 to 10 V according to the amplitude of the modulating signal, provided the modulating-signal frequency is less than the cutoff frequency determined by the modulation-signal source resistance and the Pulse Generator's .01-μF bypass capacitor.

The amplitude of the negative pulse can be modulated in the same manner with a voltage from 0 to -5 V.

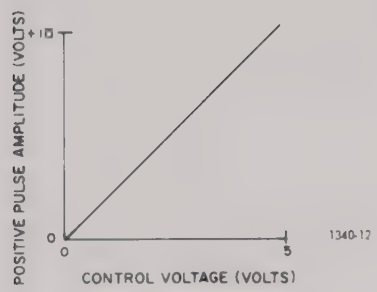

Figure 3-8. Positive output-pulse amplitude modulation characteristic.

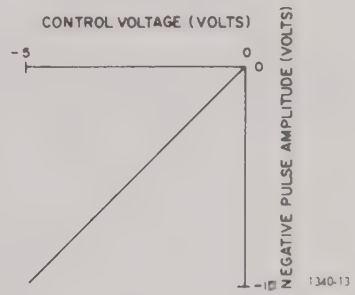

Figure 3-9. Negative output-pulse amplitude modulation characteristic.

Theory–Section 4

4.1 INTRODUCTION 4-1
4.2 BLOCK DIAGRAM DESCRIPTION 4-1
4.3 CIRCUIT DESCRIPTION 4-3

4.1 INTRODUCTION.

The 1340 Pulse Generator provides eight decade ranges of pulse period/frequencies (50 ns to 5 s/20 MHz to 0.2 Hz) and eight decade ranges of pulse duration (25 ns to 2.5 s). Provisions are made for the application of external signals, if desired, to control the pulse repetition frequency (prf); to gate the output; and to modulate the amplitude, period, and duration of the output pulses.

Both positive and negative ground-based pulses of up to 10 V and offsets to ±1 V are produced simultaneously, and their amplitude and offsets from 0 V can be independently set with front-panel controls. Pulse amplitude, pulse period/frequency, and pulse duration can also be controlled from the front panel. Control is also provided for output impedance, single pulsing, and for producing square waves.

4.2 BLOCK DIAGRAM DESCRIPTION.

Figure 4-1 shows a block of the Pulse Generator. As shown, the generator consists of six major circuits:

1. Period generator and input circuit
2. Duration generator
3. Duty-ratio overreach detector
4. Positive-pulse output amplifier
5. Negative-pulse output amplifier
6. Power supply.

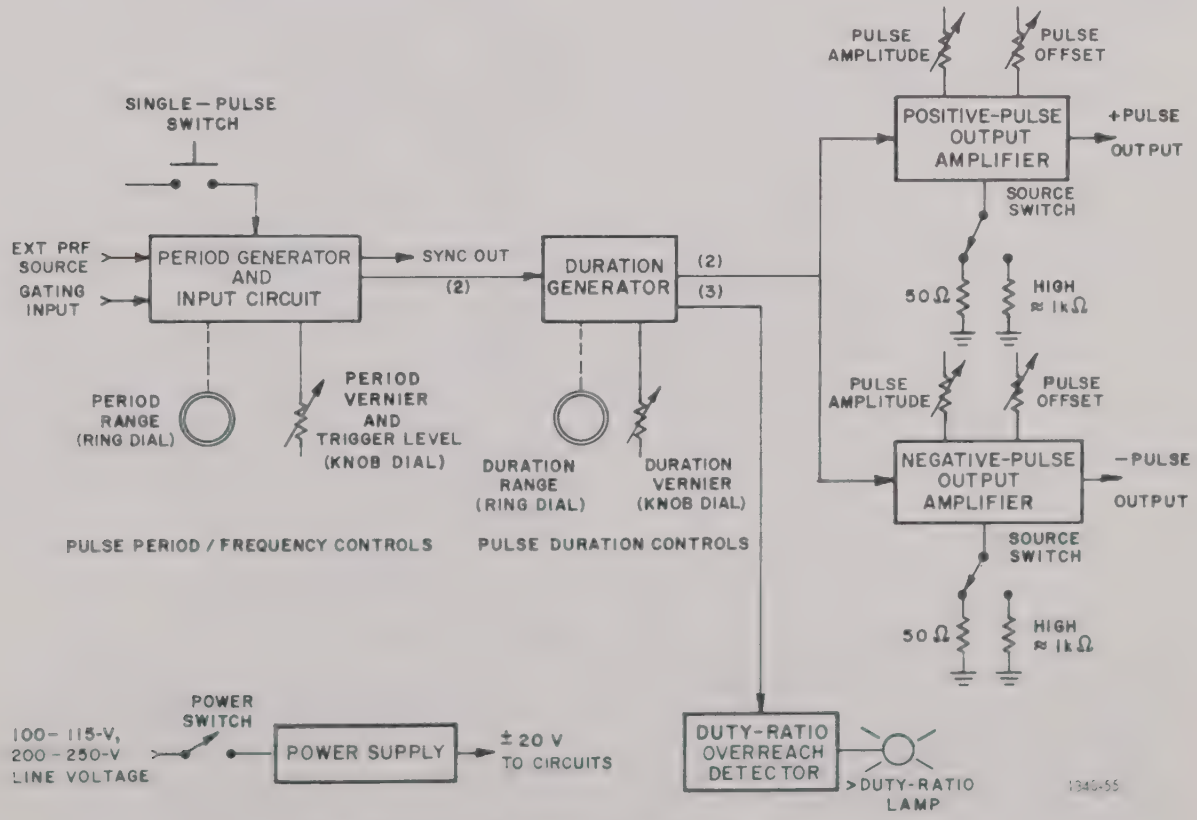

Figure 4-1. Block diagram of the 1340 Pulse Generator.

4.2.1 Period Generator.

The period generator and input circuit consists of the following circuits:

1. A novel multivibrator configuration called a voltage-variable Schmitt circuit.
2. Circuits for the application of external signals for controlling the prf and gating the output.
3. A circuit for providing a single-pulse output.

The voltage-variable Schmitt circuit produces a square-wave pulse with a period determined by the settings of the PULSE PERIOD/FREQUENCY controls. The square wave is applied to the duration circuit, where it produces a negative-going pulse that occurs at the beginning of each period, to establish a period reference and also trigger an output pulse of a duration determined by the duration generator. The square wave also establishes a synchronizing pulse at the SYNC OUTPUT connector, and is applied to the output stage of the duration circuit, through the DURATION controls, so that the square wave is available for an output, if desired.

The external prf circuit enables an external 1-Hz to 20-MHz prf source of over 3 V pk-pk, applied to the EXT PRF SOURCE connector, to control the Schmitt circuit, producing square-wave pulses with periods corresponding to the period of the external signal. The PULSE PERIOD/FREQUENCY knob dial-control acts as a trigger-level control in this mode of operation, establishing the triggering level of the input circuit.

The gating circuit allows an external gating signal with an impedance equal to or less than the 600Ω, applied at the GATING INPUT connector, to inhibit the Schmitt circuit and, therefore, the output. No pulses are "chopped" when the gate is opened and closed, i.e., the last pulse is allowed to pass if the gate signal is applied as the pulse is being produced, and the output resumes with a complete pulse.

The single-pulse circuit enables a single pulse to be produced when the PULSE PERIOD/FREQUENCY ring dial-control is set to SINGLE PULSE and the SINGLE PULSE pushbutton is pressed. This triggers the Schmitt circuit, producing a negative-going trigger pulse in the duration circuit that triggers that circuit into operation, to produce a single pulse of a duration determined by the settings of the DURATION controls.

4.2.2 Duration Generator.

The duration generator also consists mainly of a voltage-variable Schmitt circuit. The negative-going edges of the square-waves produced by the period generator, produce negative-going pulses at the input to the duration generator, corresponding to the beginning of pulse periods. These negative-going pulses trigger the Schmitt circuit, causing it to change state for a time determined by the PULSE DURATION controls. The pulses produced by the Schmitt circuit are applied to a differential amplifier in the output circuit, which, in turn, feeds the pulses to the positive- and negative-pulse output amplifiers. A pulse is produced by the Schmitt circuit each time a negative-going pulse is produced at the input.

The negative-going pulses, the pulses produced by the Schmitt circuit, and a signal produced in conjunction with the PULSE DURATION controls to hold the Schmitt circuit in its unstable state, are applied to the duty-ratio overreach detector, so that an excessive duty ratio can be detected if it occurs.

4.2.3 Duty-Ratio Overreach Detector.

The duty-ratio overreach circuit consists of a lamp circuit and a difference amplifier. The negative-going pulses that designate pulse period, the pulse that represents the pulse duration, and the pulse that controls the state of the Schmitt circuit, all of which are from the duration generator, are applied to the difference amplifier. The amplifier acts as a gate circuit, passing the negative-going pulse when the duty ratio is exceeded. This pulse triggers a monostable multivibrator, which lights the > DUTY RATIO lamp for a time determined by the RC constant that controls the state of the multivibrator.

4.2.4 Output Amplifiers.

The output amplifiers amplify the pulses received from the duration generator and provide simultaneous ground-based output pulses from 0 V up to 10 V. The positive-output pulse amplifier is identical to the negative-output pulse amplifier, except it uses positive supply voltages instead of negative supply voltages and has complementary transistor types.

The input stage consists of two input amplifiers, one of which provides current gain to drive the output stage. The output stage is a cascode-type amplifier, consisting of two pairs of parallel transistors, to handle high output current and provide fast switching.

The front-panel PULSE AMPLITUDE control allows adjustment of the amplitude of the output between 0 V and 10 V, and the PULSE OFFSET control on the front panel allows offsetting the pulse up to 1 V from the 0 V baseline. The SOURCE control on the front panel allows the selection of 50-Ω output impedance or a high output impedance, approximately 1 kΩ.

The output of the amplifiers is available at the front-panel PULSE connections.

4.2.5 Power Supplies.

Two series-regulated power supplies, operating from a full-wave bridge rectifier connected to the secondary of a power transformer, provide +20-V and -20-V supply voltage for the circuits.

The supplies are powered by either 100-150-V or 200-250-V, 50-400-Hz line voltages, applied through the power connector on the rear panel to the primary of the

power transformer. A switch on the rear panel allows selection of the desired line voltage.

Two fuses that protect the transformer and circuits are in extraction-post fuse holders inside the dust cover, behind the rear panel. The 0.4-A fuse is for 100-150-V and the 0.2-A fuse if for 200-250-V. No fuse changes are required when selecting a particular line voltage.

A power-on indicator lamp on the front panel lights when the instrument is energized.

4.3 CIRCUIT DESCRIPTION.

4.3.1 General.

Refer to Figures 6-3 to 6-6 for the following circuit descriptions.

4.3.2 Pulse-Period Generator.

The pulse-period generator (Figure 6-3) and input circuit is comprised of the following:

1. Voltage-variable period generator
2. Pulse-period/frequency control circuitry
3. External-prf input circuit
4. Gating-signal input circuit
5. Single-pulse switch circuit.

The voltage-variable period generator comprises the major part of the circuit and employs a novel multivibrator configuration — a voltage-variable Schmitt circuit — and a constant-current and switched-current source that controls the Schmitt circuit. Figure 4-2 shows a simplified schematic that illustrates the circuit operation.

Q105 and Q106 are regeneratively connected to form a Schmitt-type multivibrator. The common-emitter current supplied by R_E flows entirely in either Q105 or Q106 in the two stable states. Consider the case where Q106 is conducting (on) and Q105 and Q107 are off. Under this condition the voltage divider consisting of R1, R2, and R3, establishes a positive voltage, E_U, at the base of Q106. To keep Q105 and Q107 off, their base voltages must be more negative than the voltage at the base of Q106.

Transfer of conduction to Q105 occurs when the input voltage at the base of Q105 approaches E_U, at which point Q105 conducts, initiating the turn off of Q106; regenerative transfer of conduction to Q105 then occurs. With Q105 on, the base of Q106 is driven more negative than the base of Q107, i.e., E_L.

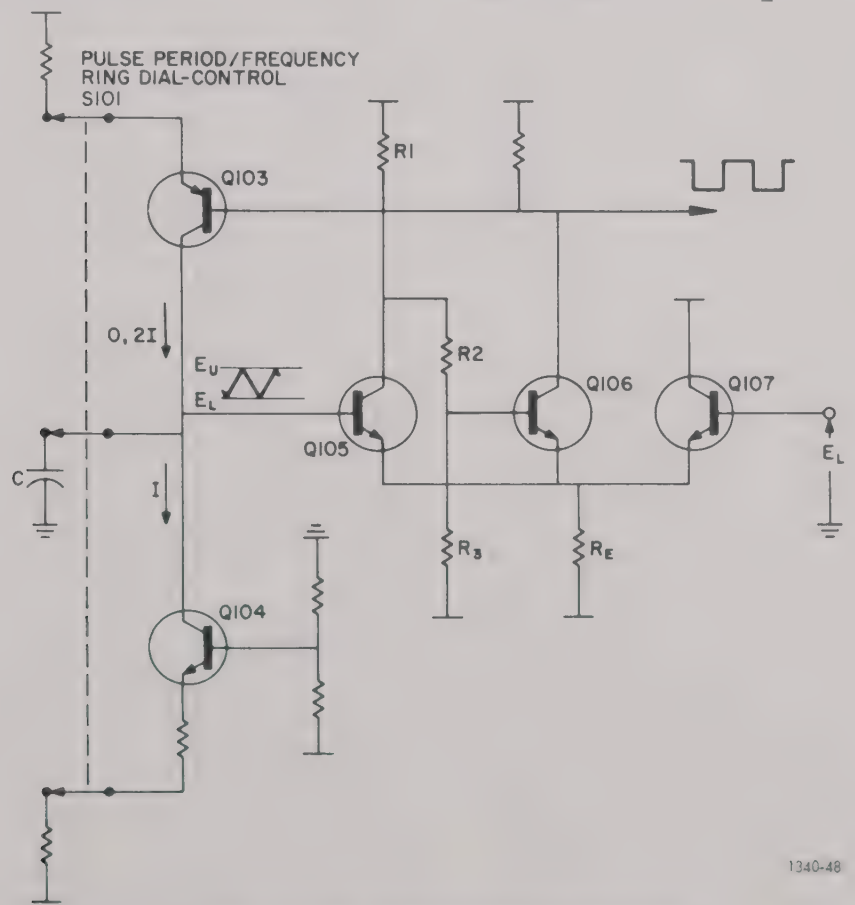

Figure 4-2. Pulse period generator simplified schematic.

To transfer conduction back to Q106, E_{IN} is lowered to near E_L. At this level, Q107 begins to draw current, reducing the current in Q105, which causes Q106 to begin conduction. The regenerative inter-connection of Q105 and Q106 again causes the emitter current to shift, this time back to Q106. Conduction is therefore shifted back and forth between Q105 and Q106 by cycling E_{IN}, first to an upper trigger-level (E_U) and then lower to a trigger-level near E_L.

The significant advantage of this circuit over other multivibrators is that the lower trigger level is easily controlled by an externally supplied voltage — in this case represented by E_L. The lower trigger-level is, in fact, almost equal to E_L.

The voltage, E_L, at the base of Q107 is established by the PULSE PERIOD/FREQUENCY knob dial-control, which adjusts the potentiometer (R107) in the voltage divider comprised of R141, R107, and R142, (refer to Figure 6-3), supplying a bias voltage divider comprised of R133 and R134, which supplies -1 V when the instrument is in the external-prf mode of operation.

R141 is an adjustment that allows the correct voltage to be applied through R107 to the base of Q107. A wire link is provided in this circuit, to allow an external modulating source to be applied to the base of Q107, if desired.

Q103 and Q104 enable the multivibrator to function as a square-wave oscillator. Q104 serves as a constant-current source, supplying a current (I, Figure 4-2) to timing capacitor C. Q103 is a switched current-source supplying no current when off and current (2I, Figure 4-2), when on. This circuit is an integrating-type circuit, responding to a positive voltage when Q103 is turned on and a negative voltage when Q103 is turned off, and produces a triangular waveshape at the base of Q105 that varies from 0 V to -0.5 V through -5.0 V, depending on the conduction of Q107.

When Q105 is on, both Q106 and Q103 are off, and the current into C is in such a direction (-I) as to cause its voltage to drop linearly with time. When the voltage reaches E_L (Figure 4-2), the voltage-variable Schmitt circuit shifts to the Q105-off-Q106-on state, causing Q103 to conduct. The capacitor current then changes direction (+I), linearly increasing the capacitor voltage. When the voltage reaches V_U, the Schmitt circuit shifts back to the Q105-on-Q106-off state again. In this manner the capacitor voltage alternates between positive and negative slopes, developing a square wave at the collector of Q106. Changes in control voltage E_L, change the pk-pk amplitude of the capacitor voltage proportionately. Since the charging currents are constant, the period of the square wave is directly proportionate to the control voltage.

The square wave at the collector of Q106 (Figure 6-3) is applied to the base of Q108. Q108 is turned on when the collector voltage of Q106 is low (approx. +16 V) and turned off then the collector voltage is high (+20 V). The collector of Q108 is connected to a differential amplifier comprised of Q109 and Q110. The base of Q110 is biased at approximately 8 V; therefore, the voltage at the base of Q109 is effectively 8 V.

When Q108 is not conducting, the voltage at the base of Q109 is below 8 V, and Q109 is turned on, producing approximately a 3-V level at the collector, which is in turn applied to the SYNC OUTPUT connector.

When Q108 is turned on, the voltage at the base of Q109 rises quickly above that at the base of Q110. Output current remains in Q109 until the voltage rise at the base of Q109 approximately equals the voltage at the base of Q110, at which point the output current abruptly changes from Q109 to Q110 and remains constant in Q110, until the voltage at the base of Q109 decreases below 8 V when Q108 is turned off.

The shift in current from one collector to the other causes a decrease in the voltage level at the collector of Q109 from approximately +3 V to 0 V and an increase in the voltage level at the collector of Q110 from 0 V to +5 V. Although a voltage swing of 300 mV around 8 V at the base of Q109 is sufficient to cause a shift in current from one collector to the other, a larger signal is used to produce faster switching.

The voltage produced at the collector of Q110 is applied to the duration circuit, to establish the pulse period.

The signal at the base of Q109 is also applied to the DURATION controls for use as a square-wave output. If the DURATION ring dial-control is set to SQUARE WAVE, the signal is applied to the output stage of the duration circuit. The resultant signal is applied to the output amplifiers, which, in turn, amplify and apply it to the output pulse connectors.

PULSE PERIOD/FREQUENCY Controls. The slope of the input signal (E_{IN}) is established with the PULSE PERIOD/FREQUENCY ring dial-control, which selects the appropriate capacitor and resistor that determine the exponential positive- and negative-going slopes of the signal applied to Q105. The input signal can vary from a positive value of 0 V to approximately -0.5 V to -5.0 V, depending on the voltage established at the base of Q107.

PRF-Input Circuit. The external-prf-input circuit consists of an emitter follower, Q101, whose input is connected to the EXT PRF front-panel connector and output connected to the base of Q105 when the PULSE PERIOD/FREQUENCY ring dial-control is set to EXT PRF.

The multivibrator operates in the same manner described previously, when a 1-Hz to 20-MHz signal greater than 3 V pk-pk is applied to the EXT PRF connector. Q103 and Q104 do not conduct, however, and the PULSE PERIOD/FREQUENCY knob dial-control acts as a trigger-level control, establishing the voltage level at the base of Q101 at which the input pulses will cause Q101 to conduct.

Q107 is biased off by approximately -1 V through the voltage divider comprised of R133 and R134, when in this mode of operation

Gate-Input Circuit. The gate-input circuit consists of switching transistor Q102, with its collector connected to the base of Q105. When a switch closure through 600 Ω to

ground is applied to the GATING INPUT connector on the front panel, Q102 is turned on, causing capacitor C to charge rapidly to approximately 0 V, if the voltage at the base of Q105 is negative. If Q105 is conducting when the switch closure to ground is applied, it remains in conduction until the ground is removed and the multivibrator resumes normal operation. Q106 remains off, with its collector voltage high, until normal operation is resumed. If Q105 is not conducting when the ground is applied, the rapid increase of voltage to 0 V at the base of Q105 turns on Q105 which, in turn, turns off Q106. The collector voltage of Q106 rises and remains at the same level until normal operation is resumed, after the ground is removed.

Because a negative transition does not occur at the collector of Q106 during this operation, coherent gating is obtained (i.e., no pulses are "chopped" and there is approximately one-half period delay before an output pulse is produced when the ground is removed), since it is the negative transition at the collector of Q106 that eventually produces a pulse that determines the pulse period and in turn produces an output pulse.

Single Pulse Circuit. When the PULSE PERIOD/FREQUENCY control is set to SINGLE PULSE, the normally closed SINGLE PULSE switch contact causes timing capacitor C105 to charge to approximately +1 V through the R144/R102 network. In this state Q105 is turned on. When the SINGLE PULSE, pushbutton is pressed, C105 is disconnected from the +20-V supply. The negative current source, Q104, then causes the voltage across C105 to sweep in the negative direction. The negative voltage eventually turns off Q105, producing a negative transition at the collector of Q107, which initiates an output pulse. The switch circuit returns to state described above when the pushbutton is released.

4.3.3 Duration Generator.

The duration generator (Figure 6-4) also uses a voltage-variable Schmitt circuit somewhat similar to that in the period generator. Q204, Q205, Q206 and Q209 comprise the multivibrator. Q203 is the constant- current generator. Q202 in this case, however, clamps the base of Q204 to ground when it is turned on.

When the multivibrator is in the stable state, Q205 is turned on. This causes current to flow in the forward direction through CR205 from the base of Q202 and junction of CR202 and R219, producing approximately -0.8 V at the base of Q202. This turns on Q202, which in turn clamps the base of Q204 to ground. The base of Q205 is slightly above ground potential when Q205 is conducting. Since the capacitor, connected through the DURATION ring dial-control to the base of Q204, cannot charge to a positive value because of the clamping action of Q202, Q204 cannot change its state, turning off Q205.

Q205 remains turned on until a negative trigger-pulse is applied to the collector of Q204. This pulse is produced at the collector of Q201 when a pulse is received from the period generator, and is fed to the collector of Q204. Q201 is conducting slightly when the input pulse is at 0 V. When the input signal goes to +5 V, Q201 is made more conductive. Capacitor C211 charges rapidly to a less positive value (but not less than the original state when Q201 was conducting slightly) and remains constant until the input pulse drops to 0 V. When this occurs, C211 discharges towards a more negative voltage through R213 in such a manner as to make the base negative with respect to the emitter, causing Q201 to turn off. Q201 remains cut off until the current through R213 decreases, causing the voltage at the emitter to be negative with respect to the base, which turns on Q201 slightly. When the next pulse is received from the period generator, the process then repeats.

Since CR201 is forward biased, the negative-going pulse is steered through the diode to the collector of Q204. The negative-going pulse turns Q205 off. This causes current to flow in the reverse direction through CR205, producing approximately +0.7 V at the base of Q202, turning it off.

The constant-current source now charges the capacitor connected to the base of Q204, and its voltage goes in the negative direction. When the voltage reaches that established at the base of Q206 (E " in Figure 4-2) the multivibrator reverts to the Q204-off-Q205-on state, in the same manner at that of the period generator described previously. Q209, however, is added to this multivibrator, to speed up switching. Q209 conducts when Q206 conducts, momentarily producing a positive voltage at the base of Q205, which speeds-up its turn-on.

The amplitude of the voltage change on the timing capacitor is set by the voltage established at the base of Q206. The output pulse duration at the collector of Q205 is therefore linearly proportional to the control voltage at the base of Q206.

The PULSE DURATION controls act in nearly the same manner as the PULSE PERIOD/FREQUENCY controls. The knob dial-control establishes the control voltage at the base of Q206. This voltage can be varied from -0.5 V to -5.0 V (approximately). A wire link is provided in this circuit for the application of an external signal to the base of Q206, if desired, for modulating pulse duration. The ring dial-control establishes the slope of the signal applied to the base of Q204, in effect, the pulse-duration range. The control also allows a square-wave signal to be available at the OUTPUT PULSE terminals.

Zener diode CR205 clamps the collector of Q205 to 8.2 V. When Q205 conducts, the voltage drops to 7.4 V, and when not conducting, rises to 8.9 V; therefore, a voltage swing of 1.5 V around 8.2 V is produced. This pulse is fed to the differential amplifier comprised of Q207 and Q208

for amplification and application to the positive- and negative-output pulse amplifiers. The base of Q208 is biased at 8 V. The base of Q207 is at 8 V, and the input signal swings 1.5 V around the 8-V level, switching the current flow between Q207 and Q208 in the same manner as the differential amplifier in the period generator described previously. This produces pulses at the collectors, which alternately go from negative to positive levels; i.e., when the output to the positive-pulse amplifier is positive, the output to the negative pulse-amplifier is negative, and vice versa.

The negative-going pulse at the collector of Q201 is applied to the duty-ratio overreach detector to establish a period reference. The voltage sweep at the base of Q204 and the waveform at the collector of Q205 are also applied to the duty-ratio overreach detector, so that an excessive duty ratio can be detected if it occurs and an indication provided.

4.3.4 Duty-Ratio Circuit.

The duty-ratio overreach detector (Figure 6-6) is comprised of two parts; a monostable multivibrator (MM) and a difference-amplifier. The MM includes Q303 and Q304 and is triggered by a pulse steered through the difference amplifier, comprised of Q301 and Q302.

Multivibrator. In the stable state, Q303 is conducting, being biased "on" by current flowing through R301 and the base. Q303 remains on even when Q302 is turned on, except when a trigger pulse from the duration generator is applied to the common emitters of Q301 and Q302, and the duty-ratio is exceeded.

Since Q303 is on, Q304 is turned off, and C303 is charged up to collector voltage of Q304. The > DUTY RATIO LAMP is not lighted since current flow through the lamp is small.

When the current through R301 drops sufficiently, Q303 is turned off. Its collector voltage then rises, turning on Q304. The collector current of Q304 increases, causing an increase in current through the lamp filament, turning on the lamp. The collector voltage drops and C303 discharges through R308 and Q304. The discharge current through R308 produces a voltage drop that biases Q303 below cutoff. As C303 continues to discharge, the current through R308 decreases exponentially. Eventually, the drop across R308 is no longer sufficient to keep Q303 cutoff. The current through R301 and the base of Q303 then causes Q303 to become conductive, biasing Q304 below cutoff. Current through the lamp filament decreases, and the lamp is turned off. Therefore, the length that the lamp is turned on is determined by the RC constant produced by R308 and C303.

Difference Amplifier. The difference amplifier can be considered to operate in two modes; normal operation (> DUTY RATIO lamp not flashing), and "lamp-flashing" mode. The particular mode of operation is based on the ability of Q302, acting as a gate, to pass a trigger pulse applied at the common emitter of Q301 and Q302, to the base of Q303, causing the MM to change its state and light the lamp.

In normal operation the trigger pulse is steered to ground through Q301. In the lamp-flashing mode, when the duty-ratio is exceeded, Q302 is enabled, steering the trigger to the base of Q303.

Figure 4-3 illustrates the operation of the circuit; idealized waveforms are shown for this purpose. A trigger pulse (A, Figure 4-3), whose timing is based on the selected pulse period, is coupled from the duration generator to the common emitters of Q301 and Q302. A negative-going sweep voltage (B, Figure 4-3) from the collector of Q202 in the duration generator is applied simultaneously to the base of Q301, biasing Q301 below cutoff. A positive pulse (C, Figure 4-3) from the base of Q202 in the duration generator is applied to the base of Q302, causing Q302 to become conductive. However, the conduction is such that the current through Q302 is not sufficient to produce a decrease in current to the base of Q303, biasing it below cutoff. Q303 is held in conduction (D, Figure 4-3), even when the pulse applied to the base goes negative, as long as Q301 is at cutoff, since at this time the base of Q302 is positive with respect to the emitter.

If the pulse duration is increased, the sweep-voltage duration is increased correspondingly (E, Figure 4-3). If the duty ratio is exceeded, a trigger pulse will occur during the time Q301 is cutoff. The negative pulse is coupled through C301 and R303 to the emitters. Since Q301 is cutoff, the pulse causes the base of Q302 to become more positive with respect to the emitter. This increases the current flow through Q302 (F, Figure 4-3), causing a decrease in current to the base of Q303, which turns it off. The MM then operates in the manner described previously in this paragraph.

4.3.5 Output Amplifiers.

The following is a description of the positive-output pulse amplifier (Figure 6-5). The negative-output pulse amplifier is the same type as the positive-output pulse amplifier, except that negative supply voltages and complementary transistor types are used; therefore, only the positive-pulse amplifier is described.

The output of the duration circuit is applied to the base of Q403. Q403 is normally saturated and is turned off by the input pulse when it goes positive. The pulse produced at the collector is then applied to the base of Q403. The positive pulse PULSE AMPLITUDE control (R401) regulates the conduction of Q401 and Q402, which control the amplitude of the collector supply voltage, and, therefore, the amplitide of the pulse applied to Q404.

Q404 is a nonsaturating amplifier that provides current gain to drive the output stage. The output stage is a cascode type, i.e., a grounded emitter-type amplifier (Q405 and Q406) driving a grounded-base-type amplifier (Q407 and Q408). These amplifiers are comprised of parallel pairs of transistors for handling high output current, yet maintaining a fast switching speed.

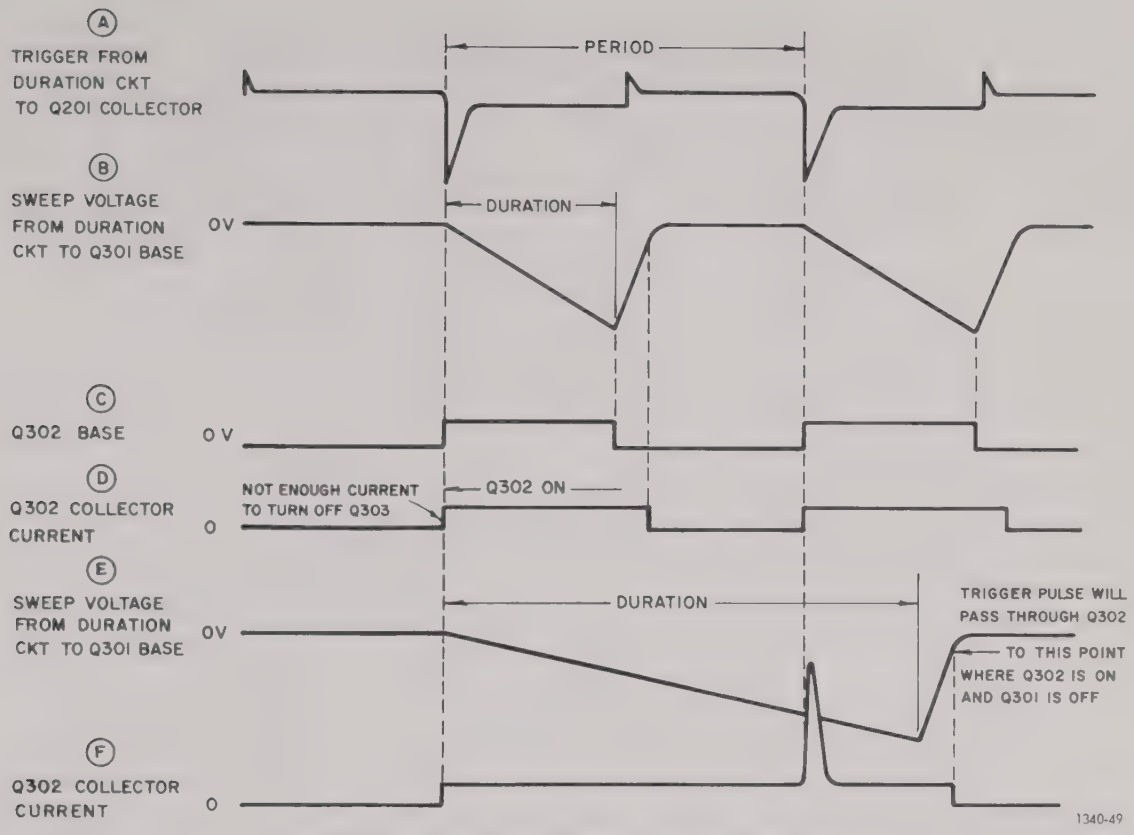

Figure 4-3. Duty-ratio overreach detector waveforms (idealized).

The output-stage amplifiers are nonsaturating, having very fast rise times. This allows the output amplitude to be proportional to the control voltage established with the PULSE AMPLITUDE control. An external voltage source (0 - 10V) can be applied to the wire link at the base of Q401 as a substitute control voltage, if desired, for modulating the output-pulse amplitude.

The front-panel positive-pulse PULSE OFFSET control (R403) allows the addition or subtraction of 20-mA output current for offsetting the output pulse from the 0-V baseline. The front-panel source switch allows selection of a 50-Ω output impedance (R402) or a high output impedance (R421).

For further details concerning the output pulse-amplifier circuits, refer to paragraphs 3.9 and 3.10 for a description of the amplifiers' equivalent output impedance circuits, depicted in Figure 3-1, and a description of pulse-offset control, respectively.

4.3.6 Power Supply.

The power supply (Figure 6-6) consists of a transformer with a center-tapped secondary and a full-wave rectifier circuit to produce +20 V and -20 V.

The +20-V supply consists of a Darlington-connected series-regulated circuit comprised of transistors Q501 and Q502, current-limiting transistor Q503, error amplifier Q504 (Q502 can also be considered an error amplifier), and voltage-reference diode CR505.

Q502 is normally turned-on, holding Q502 in conduction. The base of Q504 is connected to potentiometer R506 in the voltage divider comprised of R505 and R507. R506 adjusts the supply for the desired output. When the output voltage increases above the adjusted voltage, Q504 conducts, reducing the current to the base of Q502 and, therefore, the current through Q501 and Q502. This regulates the output to the established level. CR505 provides a 6.8-V reference voltage for the circuit.

Q503 is normally not conducting. If a short circuit occurs in the output, the current drawn is sufficient to turn on Q503, reducing the current to the base of Q502. This in turn reduces the current to the base of Q501, causing a decrease in current through Q501. Figure 6-5 also shows a filter network fed by the supply, which, in turn, feeds bias voltage to various components.

The -20-V supply also has a Darlington-connected series-regulated circuit consisting of Q507 and Q508. R508 and R509 comprise a voltage divider, which at the emitter connection of Q505 produces approximately +0.7 V, causing Q505 to conduct. Q505 provides current to the base of Q507. This causes it to conduct, regulating the current through Q508 in the same manner as that of the +20-V supply.

If an imbalance occurs between the +20 and -20 V supplies (for example, the -20-V output increases or decreases), the voltage at the junction of R508 and R509 will increase or decrease, causing a change in current through Q505, and thereby regulate the conduction of Q507 and Q508. R513 and R514 are current-limiting resistors; C506 helps reduce transients that could cause instability.

Q506 acts in the same manner as Q503 in the +20-V supply, if a short circuit in the output occurs. Figure 6-5 also shows a filter network fed by the -20-V supply, which, in turn, feeds bias voltage to various components.

A pilot lamp is connected across the transformer secondary winding. The lamp lights when power is applied to the instrument, indicating the instrument's operational state.

Service and Maintenance—Section 5

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5.1 GR FIELD SERVICE.

Our two-year warranty attests the quality of materials and workmanship in our products. When difficulties do occur, our service engineers will assist in any way possible. If the difficulty cannot be eliminated by use of the following service instructions, please write or phone our Service Department (see last page), giving full information of the trouble and of steps taken to remedy it. Be sure to mention the serial and type numbers of the instrument.

5.2 INSTRUMENT RETURN.

Before returning an instrument to General Radio for service, please write to our Service Department or nearest District Office, requesting a "Returned Material Tag." Use of this tag will ensure proper handling and identification. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay.

5.3 MINIMUM PERFORMANCE STANDARDS.

5.3.1 General.

The following paragraphs contain information to determine that the Pulse Generator is performing within specifications. The procedures enable instrument-standards laboratories and equivalently equipped service facilities to perform checks before and after repair to determine that the instrument is operating properly. These procedures are bench checks that require the use of only front-panel controls and externally available test points (i.e., instrument disassembly is neither required or recommended).

Table 5-1 lists the recommended test equipment for a minimum performance check, adjustment procedures, and trouble analysis.

The following checks are included in this paragraph, to determine that the instrument is operating properly:

1. Pulse period/frequency
2. Duration
3. Pulse transitions and aberrations
4. Duty ratio
5. Synchronizing
6. Gating
7. External prf
8. Single pulse.

5.3.2 General Instructions.

A Tektronix Type 454 oscilloscope is recommended for all the checks, since no plug-ins are required and it has a dual-trace capability and can be used in all the measurements.

If a 1340 Pulse Generator under test does not meet a minimum performance check requirement, and no adjustment procedure is indicated, the instrument must be repaired;refer to paragraphs 5.1, 5.2, and 5.9.

TABLE 5-1
TEST EQUIPMENT

Instrument or Equipment	Requirements	Recommended*
Oscilloscope	150-MHz bandwidth, risetime 2.4 ns); basic 3% accuracy, vertical and horizontal	Tektronix Type 454
Counter (optional)	———	GR Type 1191
Oscillator	3-V pk-pk, 10-kHz sine-wave output	GR Type 1310
Voltmeter	Measure ±20-V, accuracy ±2% of reading	GR Type 1806 Electronic Voltmeter
20-dB Attenuator (2)	GR Type 874	GR Type 874-G20
3-Port Tee (2)	GR Type 874	GR Type 874-T
GR874-to-BNC Plug Adaptor (2)	Conversion from GR874 connector	GR Type 874-QBPA
50-Ω Termination (2)	GR Type 874	GR Type 874-W50
Patch Cord (2)	GR Type 874	GR Type 874-R22A
Patch Cords	———	As required
Volt-ohm-milliammeter	———	Triplett Type 630-NA

*Or equivalent

5.3.3 Pulse Period/Frequency.

Perform the following steps to check the pulse period/frequency:

a. Establish the test setup shown in Figure 5-1, using the equipment listed in Table 5-1. If a digital readout of period and duration is desired, a General Radio (GR)Type 1191 Counter can be used, as shown in Figure 5-1.

b. Connect the + PULSE and - PULSE connectors on the 1340 to channels 1 and 2 of the oscilloscope, respectively.

c. Set the 1340 controls as follows:

PULSE PERIOD/FREQUENCY	
Ring dial-control	X 10 μs
Knob dial-control	1.0
PULSE DURATION	SQUARE-WAVE
± PULSE AMPLITUDE	Full cw
± PULSE OFFSET	Centered
SOURCE	50 Ω (Pushed in)

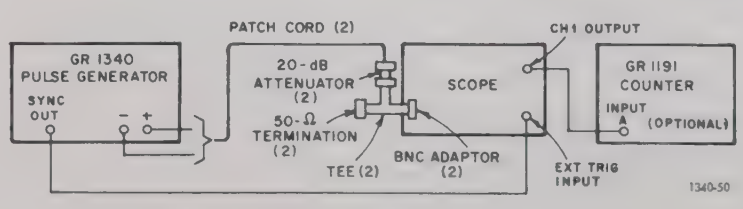


Figure 5-1. Pulse period/frequency test setup.

d. Set the oscilloscope controls as follows:

CH 1 & CH 2	
VOLTS/DIV	0.1
INPUT	DC
MODE	ALT
TRIGGER (red knob)	NORM
A SWEEP MODE	NORM TRIG
A TIME/DIV	2 μs
MAG (red knob)	OFF
A TRIGGERING	
LEVEL	0
SLOPE	—
COUPLING	AC
SOURCE	EXT

e. Turn on the 1340 according to Section 3 and turn on the output-connected instruments; make sure all interconnections are firm.

f. Adjust both of the oscilloscope vertical-position controls, so that the two pulse waveforms are centered on the display. Adjust the horizontal-position controls, to observe the first pulse after the start of the sweep.

g. Adjust both of the 1340 PULSE AMPLITUDE controls, to obtain pulse amplitude of 5 V (5 divisions).

h. With the 1340 set for a 10-μs pulse period, the output pulse should have a period of 10 μs, ±1 μs. If not, and it is desirable to obtain this accuracy, reposition the knob control-dial on the shaft according to the procedure in paragraph 5.10.

i. Set the 1340 PULSE PERIOD/FREQUENCY ring dial-control to X 100 ns and the knob dial-control to full ccw, and using the necessary sweep rates on the oscilloscope, verify that the pulse period is equal to or less than 50 ns. If the period is longer than 50 ns, refer to the adjustment procedures in paragraph 5.8.2.

j. Step the PP/F ring dial-control cw to each position. At each position, rotate the knob dial-control to full cw and back to full ccw and verify that the output pulses vary through the entire range of 50 ns to 5 s and that there are no gaps in coverage, i.e., as the period ranges are increased, the longest period on one range should be greater than the minimum period on the next higher range (ranges should overlap). Note that the extreme cw and ccw positions of the knob dial-control are used, not the ends of the calibrated scale on the dial.

k. Set the PP/F ring dial-control to X 1 s and the knob dial-control full cw (past end of scale). Observe that the period is 5 s or more. Refer to the adjustment procedure in paragraph 5.8.2 if the correct reading is not obtained.

5.3.4 Pulse Duration.

Perform the following steps to check the pulse duration:

a. Use the test setup described in paragraph 5.3.3, except change the control settings of the instruments to the following positions:

1. 1340 Pulse Generator:

PULSE PERIOD/FREQUENCY	
Ring Dial-Control	X 10 μs
Knob Dial-Control	Full cw
PULSE DURATION	
Ring Dial-Control	X 10 μs
Knob Dial-Control	1.0
± PULSE AMPLITUDE	5 V
± PULSE OFFSET	Centered
SOURCE	50 Ω

2. Oscilloscope:

CH 1 & CH 2	
VOLTS/DIV	0.1
INPUT	DC
MODE	ALT
TRIGGER (red knob)	NORM
A SWEEP MODE	NORM TRIG
A TIME/DIV	2 μs
MAG (red knob)	OFF
A TRIGGERING	
LEVEL	0
SLOPE	—
COUPLING	AC
SOURCE	EXT

b. Set the PULSE DURATION (PD) knob dial-control for a duration of 10 μs and observe the pulse duration. The pulses should have a duration of 10 μs, ±1 μs. If not, and it is desirable to obtain this accuracy, reposition the knob dial-control on the shaft according to the procedure in paragraph 5.10.

c. Set the PD ring dial-control to X 100 ns and the knob dial-control full ccw and verify that the pulse duration is 25 ns or less. If the duration is longer than 25 ns, the correct duration can be obtained, if desired, by a slight adjustment of R235. Refer to paragraph 5.8.2.

d. Set the PD ring dial control cw to each time-position. At each position, rotate the knob dial-control to full cw and back to full ccw and verify that the output pulses vary through the entire range of 25 ns to 2.5 s. When making this check, make sure that the duty ratio is not exceeded, by keeping the PP/F ring dial-control set to the same range as the PD ring dial control and keeping the PP/F knob dial-control to full cw. Verify that there are no gaps in coverage, i.e., as the duration ranges are increased, the longest duration on one range should be greater than the minimum duration on the next higher range (ranges should overlap). Note that the extreme cw and ccw positions of the knob dial-control are used, not the ends of the calibrated scale of the dial.

e. Set the PD ring dial control to X 1 s and the knob dial control to full cw (past end of scale). Observe that the pulse duration is 2.5 s or more.

5.3.5 Pulse Rise and Fall Times.

a. Establish the test setup shown in Figure 5-1.

b. Set the 1340 controls as follows:

PULSE PERIOD/FREQUENCY	
Ring Dial-Control	X100 ns
Knob Dial-Control	1.0
PULSE DURATION	SQUARE WAVE
SOURCE	50 Ω
±PULSE AMPLITUDE	5 V
±PULSE OFFSET	Centered at 0

c. Set the Oscilloscope controls as follows:

CH 1 & CH 2 VOLTS/DIV	0.1
INVERT CH 2	NORM
CH 1 & CH 2 INPUT	DC
A SWEEP MODE	NORM TRIG
A TRIGGERING	
LEVEL	0
SLOPE	+
COUPLING	AC
SOURCE	INT
TRIGGER	CH 1 ONLY
MODE	ALT
A TIME/DIV	.05 μs
MAG	OFF

d. Adjust the oscilloscope A TRIGGERING LEVEL control for proper oscilloscope operation. Position the two traces as shown in Figure 5-2 and then adjust the 1340 + and -PULSE AMPLITUDE controls to obtain 5-V (5 divisions) pulses, as shown in Figure 5-3.

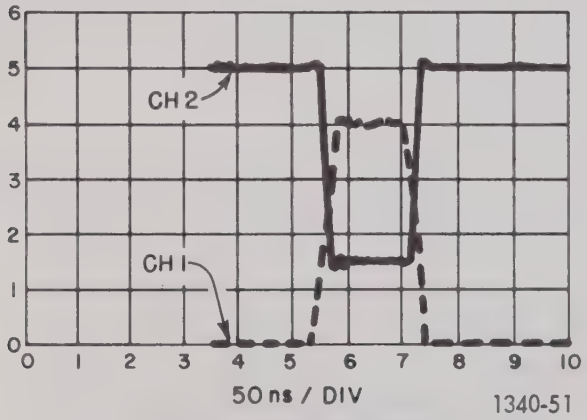


Figure 5-2. Output pulse positioning.

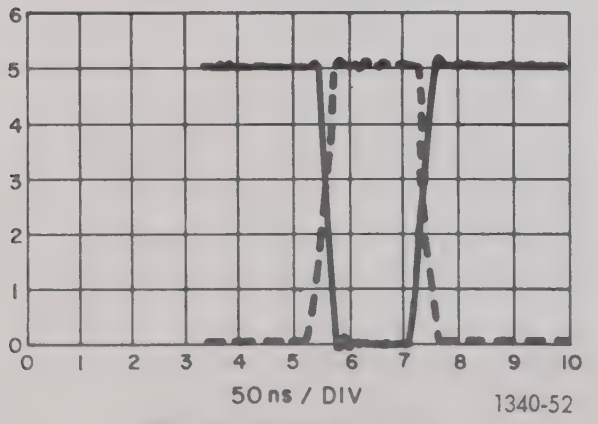


Figure 5-3. Five-V output pulses.

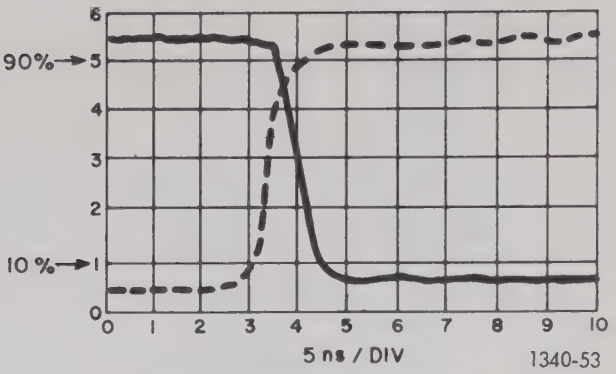


Figure 5-4. Waveforms to be measured.

e. Adjust both the 1340 ± PULSE OFFSET controls, to raise both pulses 0.5 division; set the oscilloscope MAG switch to X 10; and adjust the horizontal POSITION control, to obtain the waveforms shown in Figure 5-4.

f. Measure the rise times of both pulses, from the 10 % to 90 % points on the waveforms. The rise times should be less than 7.4 ns when measured with the Tektronix Type 454 oscilloscope (corrected to allow for the oscilloscope rise time of 2.4 ns).

NOTE

The rise time of other oscilloscopes, if used, must be taken into account. The 1340's specified rise and fall times are 5.0 ns ± 2.0 ns. The indicated rise time should be

$$\leq \sqrt{(7.0\text{ ns})^2 + (\text{scope rise time})^2}$$

g. Turn the oscilloscope's horizontal POSITION control ccw until the pulse fall-transitions appear on the display. Measure the fall times, as in step f; the fall times should be less than 7.4 ns when measured with the Tektronix Type 454 oscilloscope; see the note in step f.

5.3.6 Pulse Aberrations.

To check for pulse aberrations, continue from the above procedure or perform steps a through d in paragraph 5.3.5, above; however, set the 1340's SOURCE switch to HIGH Ω and the oscilloscope's MAG switch to OFF. Adjust the oscilloscope's vertical POSITION controls for both channels and observe the preshoot, overshoot, and ringing on each waveform. All these pulse aberrations should be less than 0.5 V (0.5 major division on the display, since a 20-dB attenuator is used in the setup). If any of the above measurements are not as specified, when measured with a conventional oscilloscope, it may be desirable to recheck them with a sampling oscilloscope.

5.3.7 Duty Ratio.

To check the duty ratio, use the same test setup as that used to check the pulse period and duration (paragraph 5.3.3). However, it is not necessary to connect to the -PULSE connector. Perform the following steps:

a. Set the 1340 controls as follows:

PULSE PERIOD/FREQUENCY	
Ring Dial-Control	X 10 ms
Knob Dial-Control	2.0
PULSE DURATION	
Ring Dial-Control	10 ms
Knob Dial-Control	1.0
SOURCE	50Ω
±PULSE AMPLITUDE	Full cw

b. Set the oscilloscope controls as follows:

CH 1 VOLTS/DIV	.5
CH 1 INPUT	DC
MODE	CH 1
A SWEEP MODE	NORM TRIG
A TRIGGERING	
SLOPE	+
COUPLING	AC
SOURCE	INT
TIME/DIV	5 ms

c. Rotate the PD knob dial-control cw slowly and observe that the duty ratio increases (i.e., the pulse duration approaches the period; refer to the definitions at the beginning of Section 3). As the duty-ratio limit is approached, a small amount of pulse period jitter or pulse pairing may occur, then the pulse period will jump to twice the previous value and the pulse duration will be approximately normal, indicating the duty-ratio limit has been exceeded. The range of duration over which jitter or pairing may be observed is very narrow and may not be seen at all. The duty-ratio limit in this case (and any other case) should be more than 70 %. The duty-ratio limit may be from 70 % to over 90 %, depending on the particular values of period and duration established. If the duration is set much greater than the period, the period observed will be some integer multiple of the value set on the PP/F controls. Under no circumstances will the instrument be damaged by exceeding the duty-ratio limit.

d. Observe that the >DUTY RATIO lamp flashes when the duty-ratio limit is reached and remains flashing until a normal condition is re-established. The exact point at which the lamp begins to flash should be at some point in the jitter or pulse-pairing phase described above. In all cases the lamp should be flashing when the period is two or more times the normal value.

5.3.8 Gating.

To check pulse gating:

a. Perform steps a and b in paragraphs 5.3.7, above.

b. Connect a resistance of 600Ω or less from the GATING INPUT terminal to ground, and observe that the output is inhibited when the resistor is connected.

5.3.9 Single Pulse.

To check single-pulse operation:

a. Perform steps a and b in paragraph 5.3.7, except set the oscilloscope VOLTS/DIV control to 10 μs/div, the 1340 PD ring dial-control to X 10 μs and knob dial-control to 1.0, and the PP/F ring dial-control to SINGLE PULSE.

b. Momentarily press the SINGLE PULSE pushbutton and observe that a single pulse is produced.

5.3.10 External PRF Source.

a. Establish the test setup shown in Figure 5-5.

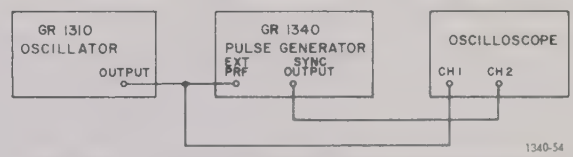


Figure 5-5. Test setup for checking the external prf function.

b. Connect the 1310 Oscillator OUTPUT 600Ω connectors to the 1340 EXT PRF connector and to the oscilloscope CH 1 INPUT connector.

c. Connect the 1340 SYNC OUTPUT connector to the oscilloscope CH 2 INPUT connector, and set the PULSE PERIOD/FREQUENCY ring dial-control to EXT PRF and the PULSE DURATION ring dial-control to SQUARE WAVE.

d. Set the oscilloscope controls as follows:

CH 1 and CH 1 VOLTS/DIV	1 V
INPUT	DC
MODE	ALT
TRIGGER	CH 1 ONLY
A SWEEP MODE	NORM TRIG
A TRIGGERING	
LEVEL	0
SLOPE	+
COUPLING	AC
SOURCE	INT
A TIME/DIV	20 μs

e. Set the 1310 Oscillator for a 3-V pk-pk output.

f. Adjust the 1340 PP/F knob dial-control until a synchronizing output signal of approximately 2.5 V amplitude is obtained, indicating the instrument is being triggered properly. This test also checks the synchronizing output signal for proper amplitude. The duty ratio of the synchronizing signal depends on the trigger level.

5.4 COMPONENT LOCATIONS.

All circuits are on one circuit board in the instrument. Figure 5-6 shows the locations of internal adjustments and

various components. Components are reference designated according to the circuits they are in. Table 5-2 lists the reference designation groupings according to the circuits.

Figures 6-1 to 6-6 identify the locations of components on the circuit boards. In the schematics, components prefixed with the letter B are on the circuit board. The components prefixed with the letter A are on the front panel or on the switch wafers.

NOTE

There are a few parts that are not in early production units. These units have the identification number ID-B100 and ID-B826. The parts are shown in Figure 6-3 and are identified by an asterisk in the replaceable-parts lists.

TABLE 5-2
REFERENCE DESIGNATIONS

Component Numbers	Circuit
100-199	Period generator and input circuit
200-299	Duration generator
300-399	Duty-ratio overreach detector
400-499	Positive-pulse output amplifier
500-599	Power supply
600-699	Negative-pulse output amplifier

5.5 CHASSIS REMOVAL-REPLACEMENT

To gain access to the components and internal adjustments, loosen the two captive screws on the rear of the cabinet and carefully slide the chassis out of the cabinet. Reverse this procedure, to replace the chassis.

5.6 SERVICING ETCHED-CIRCUIT BOARD.

The 1340 has one etched circuit board. The board has the parts on one side and the circuitry on the opposite side.

When removing or replacing parts, use a low-heat soldering iron and a small-diameter rosin core solder. Do not subject the parts or boards to excessive or prolonged heat. Parts can be removed by placing the soldering iron on the component lead on the circuit side of the board and pulling up on the lead from the part side. If a part is obviously faulty or damaged, clip the leads close to the part and then remove the leads from the circuit side.

The part lead hole should be cleaned before inserting a new lead. Heat the solder in the hole, quickly remove the soldering iron, and insert a pointed nonmetallic object such as a toothpick, or use a "solder sucker."

Shape the new component leads, insert them in to holes, reheat with the iron, and add solder as necessary to form a good electrical connection. Clean any excess flux from the connection and adjoining area.

5.7 TEST POINTS.

Signal measurements can be made at anchor terminals (AT's) on the circuit board. The terminals are identified in the illustrations and schematics in Section 6. AT's on the circuit board are not prefixed by letters.

5.8 ADJUSTMENTS.

5.8.1 General.

The following adjustment procedures should be performed only when it has been definitely established that the Pulse Generator is out of adjustment as determined by symptoms during operation, by performance checks, or after corrective maintenance has been performed. Table 5-1 lists the equipment required for adjustments.

5.8.2 Period Adjustment.

Perform the following steps to adjust the pulse period/frequency:

a. Remove the chassis from the cabinet according to paragraph 5.5.

b. Perform steps a through g in paragraph 5.3.3, except set the PP/F knob dial-control to full ccw.

c. Adjust R141, to obtain a period of 4.6 μs.

d. Recheck the position of the PP/F knob on the shaft, as described in paragraph 5.3.3, step h.

e. Set the PP/F knob dial-control full ccw, the ring dial-control to 100 ns, and the oscilloscope TIME/DIV controls to .05 μs/DIV (X 10).

f. Adjust R235 for the best square wave obtainable.

5.8.3 Duration Adjustment.

To adjust the pulse duration, perform steps a and b in paragraph 5.3.4 (after first verifying the pulse-period accuracy, and adjusting if necessary).

5.8.4 Power Supply.

Perform the following steps to adjust the power supply output:

a. Remove the chassis from the cabinet and connect a GR 1806 Electronic Voltmeter, or equivalent, to the +20-V supply at the wire link beside Q501. (See Figure 5-6 for the location.)

b. Adjust R506 for a +20-V reading.

c. Connect the voltmeter to the case of Q508 and measure the -20-V supply output. The voltage should be -20 V, $\pm$ 0.3V.

5.9 TROUBLE ANALYSIS.

Table 5-1 lists the equipment recommended for trouble analysis. Table 5-3 lists most of the symptoms of

malfunctions that can occur in the instrument, and the circuit(s) to be checked to isolate the fault. Table 5-4 contains the circuit test and test data for isolating the fault to the circuit and circuit components, and contains illustrations showing the actual waveforms appearing at various points in the circuits.

The schematic diagrams of the circuits (Section 6) show the dc voltages at significant points in the circuits for various operating conditions, as stated on the schematic. Idealized waveforms are also shown at significant points on the schematics.

Obvious checks that should be performed before trouble analysis are not listed in the tables. These include power and power connections, fuses, lamps, etc. The instrument should also be inspected for broken and short-circuited wiring and damaged or faulty components.

Use the panel controls whenever possible, to determine which circuit has failed. For example, failure to obtain a correct output on only one range of pulse period/frequency or pulse duration is a good indication that the capacitor associated with the particular ring dial-control position has failed, or there is a poor switch connection. Also, failure of only one pulse output (positive or negative), or the failure to adjust one output, indicates a failure in the respective output amplifier.

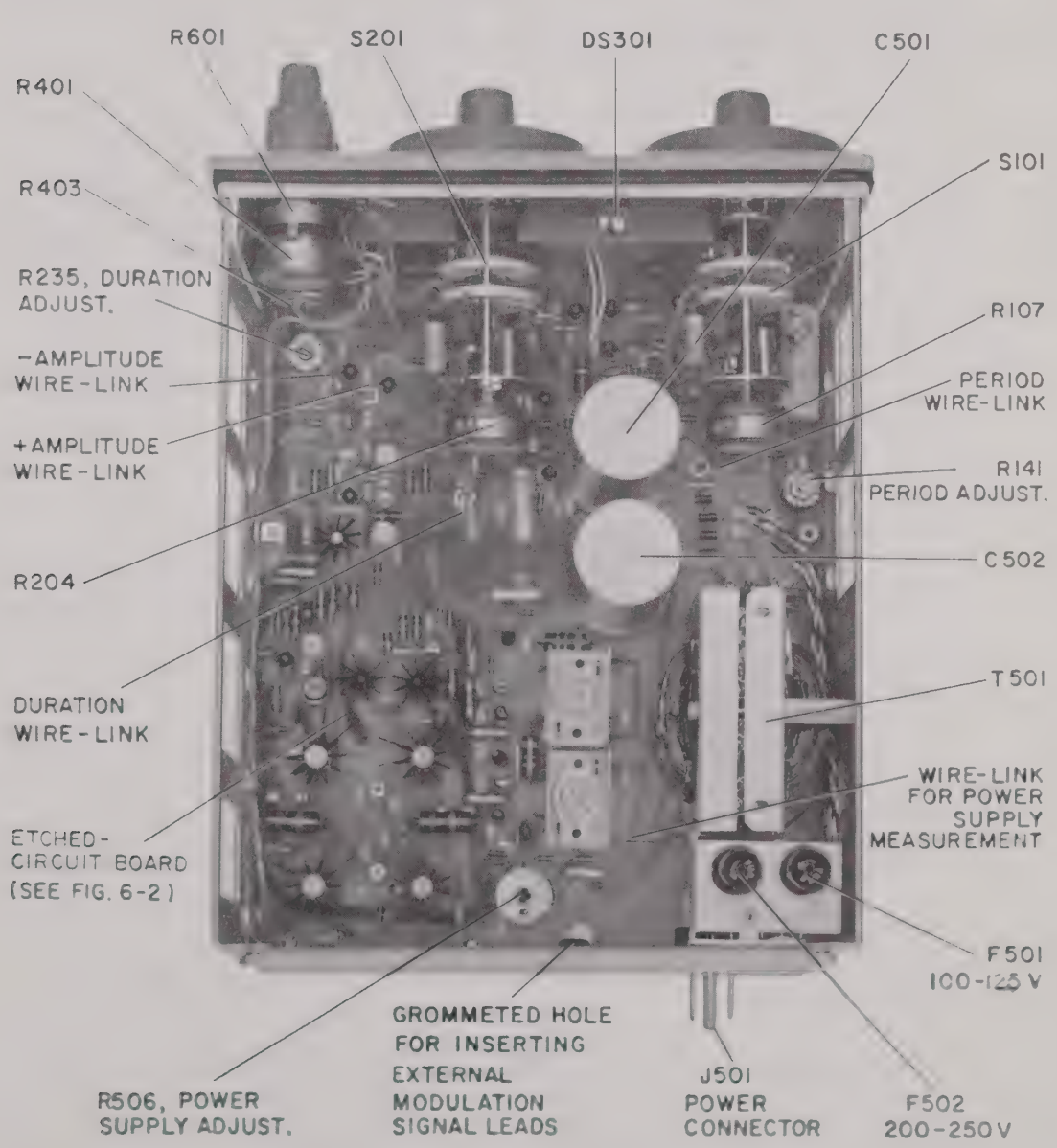


Figure 5-6. Top view of the 1340 with the cabinet removed.

TABLE 5-3
FAULT INDICATIONS AND PROBABLE CAUSES

Symptom	Probable Cause	Comments
No positive or negative output pulses, no synchronizing pulse output, and no square wave at anchor terminal AT-32.	Power supply, period generator and input circuit, and/or the PULSE PERIOD/FREQUENCY controls.	
Same as above, except a square wave output is available at AT-32 and the front panel.	Period generator differential output amplifier (Q109-Q110) and/or the duration generator.	If the sync pulse is available, the period generator differential output amplifier should be functioning properly. If so, check the duration generator.
Same as first symptom, except the sync pulse is available at the front panel and a square wave is available at AT-32 and the front panel.	Duration generator..	
Same as the first symptom, except the sync pulse is available at the front panel and a square wave is available at AT-32 but not at the front panel.	Duration generator and/or its differential output amplifier (Q207-Q208), output amplifiers, and/or the PULSE DURATION controls.	This fault can be isolated by exceeding the duty ratio and observing if the >DUTY RATIO lamp flashes. If so, the fault is not in the duration generator (with the exception of difference output amplifier, Q207-Q208).
Only one output pulse (positive or negative) is available.	Applicable output amplifier.	
The correct pulse period/frequency does not occur for a particular range(s) but occurs for other ranges.	Associated part of the PULSE PERIOD/FREQUENCY control; see schematic, Figure 6-3.	
The correct pulse duration does not occur for a particular range(s) but occurs for other ranges.	Associated part of PULSE DURATION control; see schematic, Figure 6-4.	
Erratic or incorrect output pulses occur.	Out of adjustment or same as cause for first four symptoms.	Refer to adjustment procedures in paragraph 5.8.
Generator functions properly, except single pulse, external prf and/or gating input functions do not function properly.	Associated circuitry; see schematic, Figure 6-3	
± PULSE AMPLITUDE and/or PULSE OFFSET control(s) do not function properly.	Associated part of output amplifiers; see schematic, Figure 6-5.	
> DUTY RATIO lamp does not flash when duty ratio is exceeded.	Lamp and/or duty-ratio overreach circuit.	
Poor pulse rise or fall times.	Output amplifiers.	
Poor square wave output (pulse duration not equal to "off" time).	Out of adjustment.	Refer to paragraph 5.8.2.
Pulse period not correct on all ranges.	Out of adjustment.	Refer to paragraph 5.8.2.
Pulse duration not correct on all ranges.	Out of adjustment.	Refer to paragraph 5.8.3.

Table 5-4
TEST TABLE

POWER SUPPLY

For resistance checks, set the controls as follows:

± PULSE AMPLITUDE	0
± PULSE OFFSET	0
SOURCE	HIGH Ω
Line-Voltage Selector	200-250
POWER	ON
Other controls	As desired.

For voltage measurements, set the controls as follows:

PULSE PERIOD/FREQUENCY	SINGLE PULSE
PULSE DURATION	SQUARE WAVE
± PULSE AMPLITUDE	FULL ccw
± PULSE OFFSET	Centered
SOURCE	Any position
POWER	ON.

Test No.	Test	Measurement Between	Nominal Voltage or Resistance	If Test Fails
1.	RESISTANCE (measured with VOM)	Chassis to power line high (H) and low (L)	∞ Ω	Check wiring, voltage selector switch and power connector.
		Power line high to power line low	60-75 Ω	Same as above.
		Set Line-Voltage Selector Switch to 100-125V.		
		Power line high to power line low	15-17 Ω	Same as above.
		SYNC OUTPUT connectors to ground	480-520 Ω	Check wiring.
		+PULSE output connector to ground. (SOURCE switch set to HIGH Ω)	1k Ω (Reverse probes if meter reads low).	Check that the OFFSET control is centered. Check wiring, selector switch, and power connector.
		Same as above with SOURCE switch set to 50Ω.	48-52 Ω	Check SOURCE switch and same as above.
		-PULSE output connector connector to ground (SOURCE switch set to HIGH HIGHΩ)	1kΩ (Reverse probes if meter reads low).	Same as above.

Table 5-4 (Cont'd)
TEST TABLE

Test No.	Test	Measurement Between	Nominal Voltage or Resistance	If Test Fails
	RESISTANCE (CONT'D)	Same as above with SOURCE switch set to 50Ω.	48-52Ω	Check SOURCE switch and same as above.
2.	VOLTAGE (Measure with a GR 1806 Electronic Voltmeter, or equivalent)	Q501 wire link (see Fig. 5-6) and ground.	+20 Vdc	Perform adjustment procedure in para. 5.8.5; check associated components if unable to obtain correct voltage.
		Case of Q508 and ground.	-20 Vdc, +0.3 V	Perform same as above.

PERIOD GENERATOR AND INPUT CKT

Set the controls to the following positions, for testing this circuit:

PULSE PERIOD/FREQUENCY	
Ring Dial-Control	X100μs
Knob Dial-Control	0.5
PULSE DURATION	SQUARE WAVE
± PULSE AMPLITUDE	Full cw
± PULSE OFFSET	Centered
SOURCE	50Ω

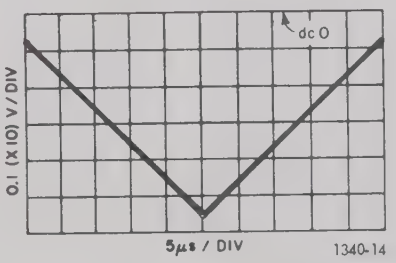
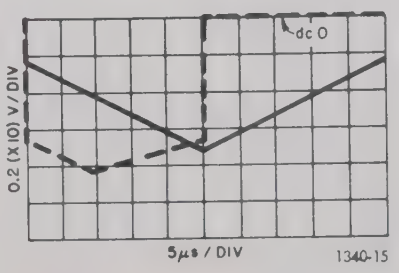
Test No.	Test	Measured To Ground From	Typical Voltage Waveform	If Test Fails
3.	PERIOD GENERATOR & INPUT CKT			
		Q103 collector		Check associated components and PULSE PERIOD/FREQUENCY (PP/F) controls.
		Q104 collector & Q106 base		Same as above.

Table 5-4 (Cont'd)
TEST TABLE

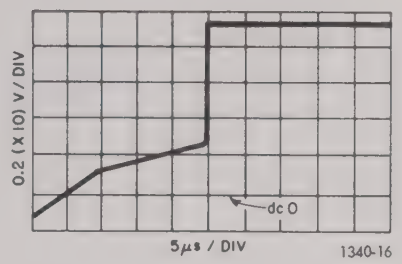
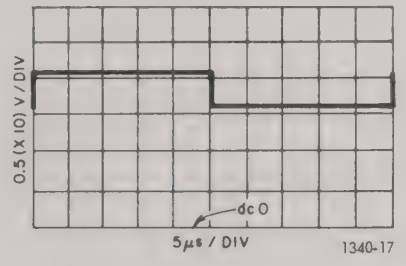
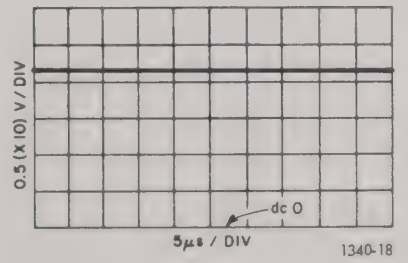
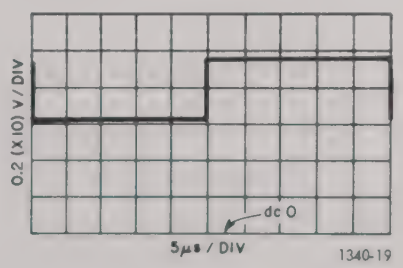
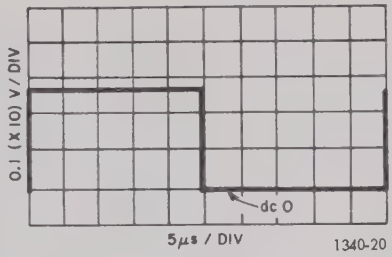
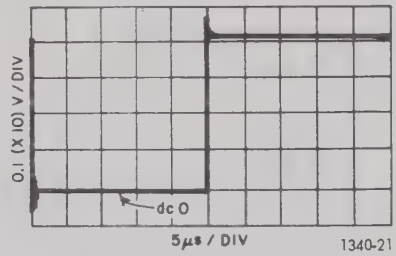
Test No.	Test	Measured to Ground From	Typical Voltage Waveform	If Test Fails
	PERIOD GENERATOR & INPUT CKT (CONT'D)			
	Monostable Multivibrator	Q105 collector		Same as above.
		Q106 collector		Check associated components.
		Q107 collector		Check associated components
	Amplifier	Q108 collector		Associated components, monostable multivibrator, Q103, and Q104.

Table 5-4 (Cont'd)
TEST TABLE

Test No.	Test	Measured To Ground From	Typical Voltage Waveform	If Test Fails
	PERIOD GENERATOR & INPUT CKT (CONT'D)			
	Differential Amplifier	Q109 collector		Check associated components, Q108, and Q110.
		Q110 collector		Check associated components.

DURATION GENERATOR

Set the controls to the following positions, for testing this circuit:

PULSE PERIOD/FREQUENCY	
Ring Dial-Control	X100μs
Knob Dial-Control	0.5
PULSE DURATION	
Ring Dial-Control	X100μs
Knob Dial-Control	0.25
± PULSE AMPLITUDE	Full cw
± PULSE OFFSET	Centered
SOURCE	50Ω

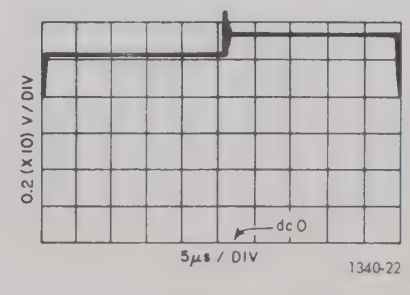
Test No.	Test	Measured To Ground From	Typical Voltage Waveform	If Test Fails
4.	DURATION GENERATOR			
	Input	Q201 collector		Check Q109 and Q110 in period generator and components associated with Q201.

Table 5-4 (Cont'd)
TEST TABLE

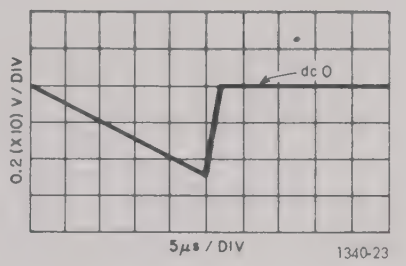
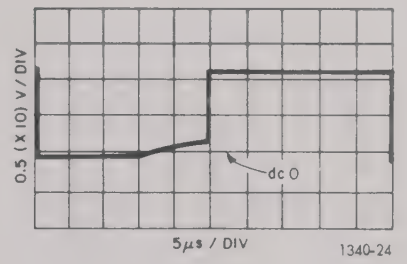
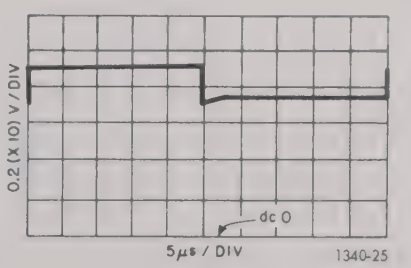
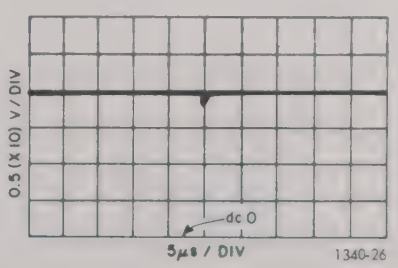
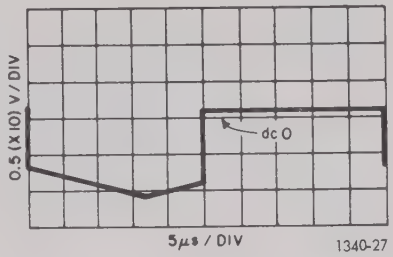
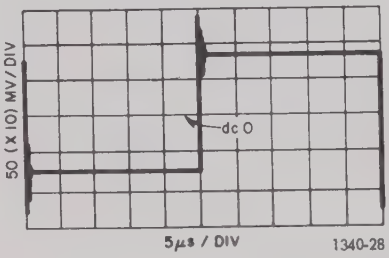
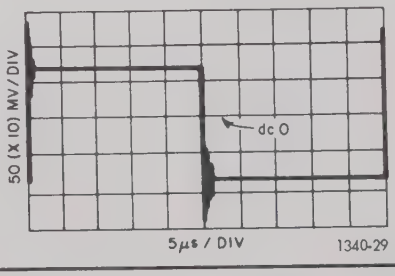
Test No.	Test	Measured To Ground From	Typical Voltage Waveform	If Test Fails
	DURATION GENERATOR (CONT'D)			
		Q202 collector		Check associated components and multivibrator.
	Monostable Multivibrator	Q204 collector		Check associated components, PULSE DURATION control, Q201-Q203.
		Q205 collector		Check associated components.
		Q206 collector		Check associated components and PULSE DURATION control.

Table 5-4 (Cont'd)
TEST TABLE

Test No.	Test	Measured To Ground From	Typical Voltage Waveform	If Test Fails
	DURATION GENERATOR (CONT'D)			
	Monostable Multivibrator (Cont'd)	Q209 collector		Check associated components.
	Differential Amplifier	Q207 collector		Check multivibrator, Q201-Q203, PULSE DURATION control, and Q208.
		Q208 collector		Check Q207, associated components and same as in Q207, above.

OUTPUT AMPLIFIERS

Set the controls to the following positions, for checking this circuit:

PULSE PERIOD/FREQUENCY	
Ring Dial-Control	X100 μs
Knob Dial-Control	0.5
DURATION controls	SQUARE WAVE
± PULSE AMPLITUDE	Full cw
± PULSE OFFSET	Centered
SOURCE	50Ω.

Table 5-4 (Cont'd)
TEST TABLE

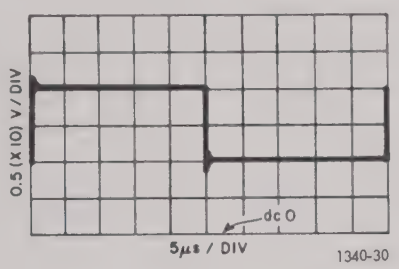
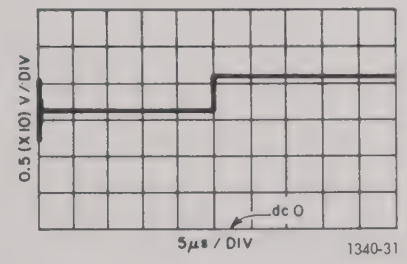
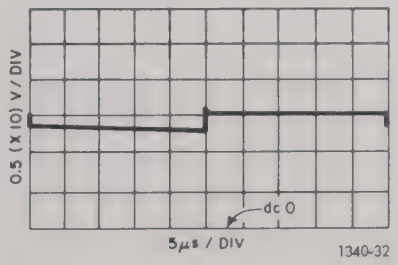
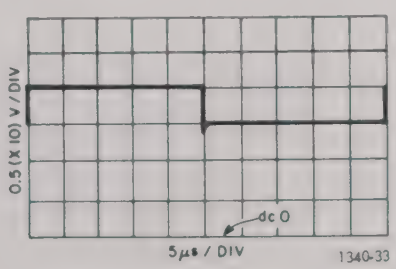
Test No.	Test	Measured To Ground From	Typical Voltage Waveform	If Test Fails
5.	OUTPUT AMPLIFIERS			
	Positive-Pulse Amp.	Q404 collector		Check Q403, duration generator, Q402, Q403, and + PULSE AMPLITUDE control.
		Q402 collector		Check associated components.
		Q405, Q406 collector		Check associated components.
	NOTE If circuit operates correctly to this point, but proper output pulse does not occur at the front panel, check Q407-Q408, SOURCE control, + PULSE OFFSET control, and associated components.	Q405, Q406 base		Check associated components.

Table 5-4 (Cont'd)
TEST TABLE

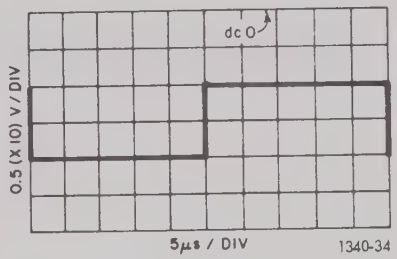
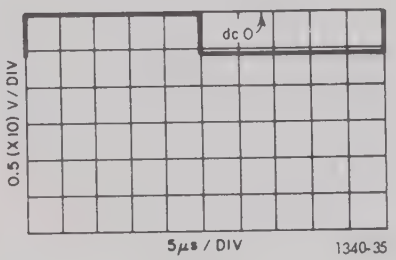
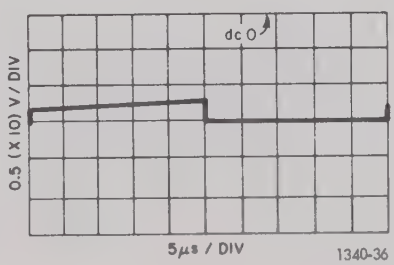
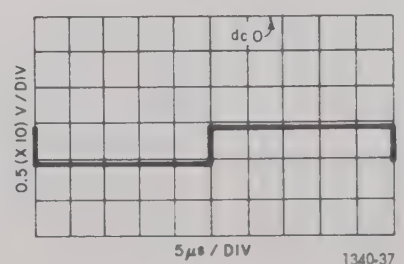
Test No.	Test	Measured To Ground From	Typical Voltage Waveform	If Test Fails
	OUTPUT AMPLIFIERS (CONT'D)			
	Negative-Pulse Amp.	Q604 collector		Check Q602, duration generator, Q601, Q603, and -PULSE AMPLITUDE control.
		Q602 collector		Check associated components.
		Q608, Q609 collector		Check associated components.
	NOTE If circuit operates properly to this point, but proper output pulse does not occur at the front panel, check Q606, Q607, Q610, -PULSE OFFSET control, and associated components.	Q608, Q609 base		Check associated components.

Table 5-4 (Cont'd)
TEST TABLE

DUTY-RATIO OVERREACH DETECTOR (Test is with duty-ratio exceeded; refer to test No. 7 for testing during normal operation.)	Set the controls to the following positions for checking this circuit: PULSE PERIOD/FREQUENCY Ring Dial-Control — X100 μs Knob Dial-Control — 0.5 PULSE DURATION Ring Dial-Control — X100 μs Knob Dial-Control — 1.0 ± PULSE AMPLITUDE — Full cw + PULSE OFFSET — Centered SOURCE — 50Ω.

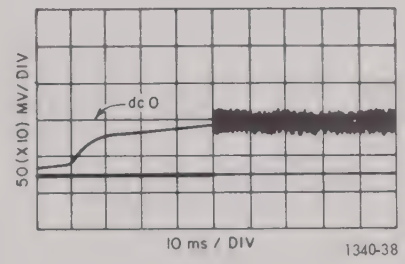
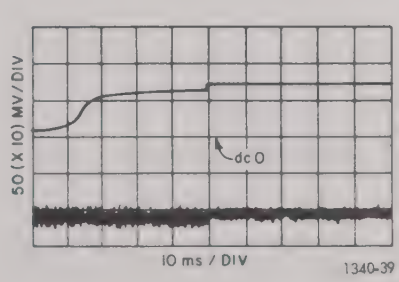
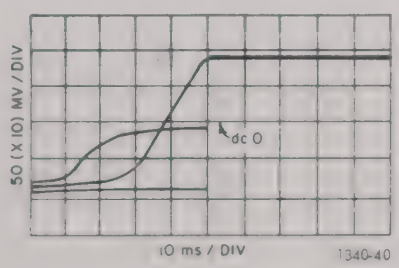
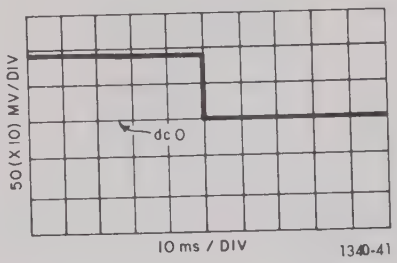
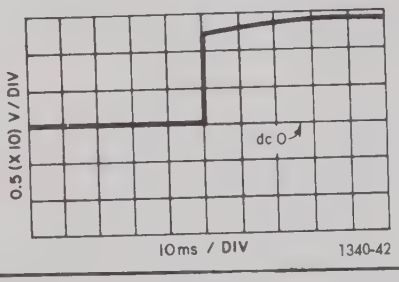
Test No.	Test	Measured To Ground From	Typical Voltage Waveform	If Test Fails
6.	DUTY-RATIO OVERREACH DETECTOR			
	Input	Q302 emitter		Check Q301, duration generator, and associated components.
		Q302 base		Check duration generator and associated components.
		Q302 collector		Check associated components.

Table 5-4 (Cont'd)
TEST TABLE

Test No.	Test	Measured To Ground From	Typical Voltage Waveform	If Test Fails
	DUTY-RATIO OVERREACH DETECTOR			
	Multivibrator	Q303 collector		Check input circuit and associated components.
	NOTE For this measurement, the oscilloscope should be triggered externally with the negative-going edge of the sync pulse, and the measurement made at AT-35.	Q304 collector		Check associated components.

DUTY-RATIO OVERREACH DETECTOR (Test with controls set to operate normally—duty-ratio not exceeded.)	Set the controls to the following positions for this test:
	PULSE PERIOD/FREQUENCY
	Ring Dial-Control — X100μs
	Knob Dial-Control — 0.5
	PULSE DURATION
	Ring Dial-Control — X100μs
	Knob Dial-Control — 0.25
	± PULSE AMPLITUDE — Full cw
	± PULSE OFFSET — Centered
	SOURCE — 50Ω.

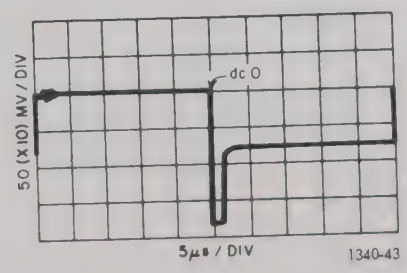
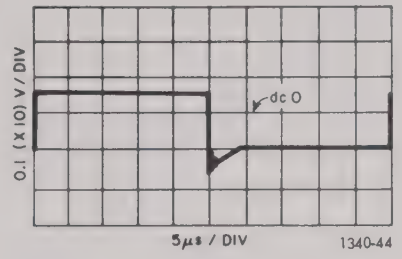
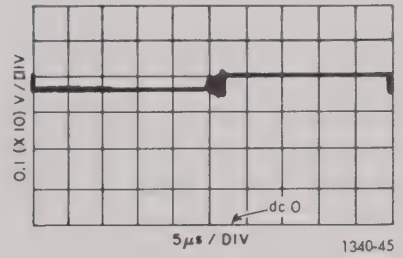
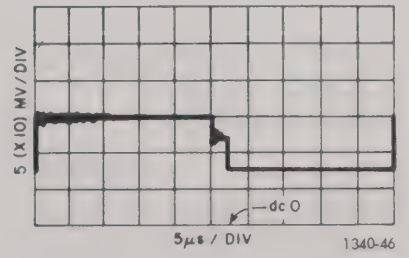
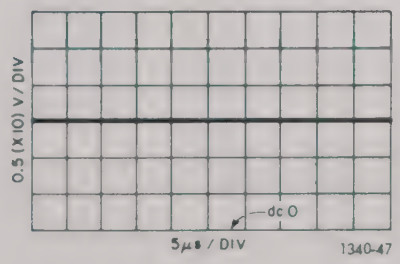
Test No.	Test	Measured To Ground From	Typical Voltage Waveform	If Test Fails
7.	DUTY-RATIO OVERREACH DETECTOR			
	Input	Q302 emitter		Check Q301, duration generator, and associated components.

Table 5-4 (Cont'd)
TEST TABLE

Test No.	Test	Measured To Ground From	Typical Voltage Waveform	If Test Fails
	DUTY-RATIO OVERREACH DETECTOR (CONT'D)			
	Input (Cont'd)	Q302 base		Check duration generator and associated components.
		Q302 collector		Check associated components.
	Multivibrator	Q303 collector		Check input and associated components.
		Q304 collector		Check associated components.

5.10 REPLACEMENT OF CONTROLS.

5.10.1 PP/F and PD Controls.

Removal. Perform the following steps to remove the controls.

a. Set the ring dial-control full ccw and the knob dial-control full ccw.

b. Hold the instrument securely and pull the control knob off with the fingers.

CAUTION

Do not use a screwdriver or other instrument to pry off the knob if it is tight, since this might mar or crack the dial. Do not lose the retention spring in the knob when the knob is removed.

c. Remove the setscrew from the bushing; use a hex-socket key wrench.

d. Remove the bushing and vernier dial.

NOTE

If the knob and dial are combined when the knob is removed, turn a machine tap a turn or two into the bushing on the dial for sufficient grip for easy separation of the knob.

e. From the ring dial bushing, remove the two setscrews; remove the bushing and dial.

f. If the switch is to be removed, remove the dress nut exposed after step e.

Replacement of PP/F Control. Install the control by reversing the removal procedure and performing the following steps:

a. Make sure the control shafts are turned full ccw.

b. Install the PP/F ring dial and bushing on the shaft so that the dial indicates EXT PRF; tighten the setscrews.

c. Establish the test setup described in paragraph 5.3.3, steps a through g, for checking the pulse period/frequency. Make sure the PD ring dial is installed properly and positioned to SQUARE WAVE.

d. Set the ring dial-control to X 10 μs and make sure the shaft of the knob dial control turned full ccw. Check that the period observed is 4.6 μs. If not, the chassis must be removed from the cabinet (refer to paragraph 5.5) and R141 adjusted to obtain this period.

e. Set the PP/F exposed shaft to obtain an output pulse period of 10.0 μs.

f. Install the knob dial on the shaft, positioned to 1.0 (period). This gives a 10-μs period, since the ring dial-control should be set to X 10 μs; tighten the setscrew on the bushing.

NOTE

Make sure that the end of the shaft does not protrude through the bushing, or the knob won't set properly.

g. Install the knob on the bushing, *making sure the retention spring is opposite the setscrew.*

NOTE

If the retention spring in the knob comes loose, reinstall it in the interior notch with the thin flange set into the small slit in the wall of the knob.

Replacement of PD Control. Establish the test setup described in paragraph 5.3.4 for checking the pulse duration and perform step a in that paragraph. Perform the following steps:

a. With the PD ring dial-control set to X 10 μs, adjust the exposed shaft to obtain an output pulse of 10 μs duration and install the knob dial and bushing so that the dial reads 1.0; tighten the setscrew.

NOTE

Make sure that the end of the shaft does not protrude through the bushing, or the knob won't set properly.

b. Install the knob on the bushing, *making sure the retention spring is opposite the setscrew.*

NOTE

If the retention spring in the knob comes loose, reinstall it in the interior notch with the thin flange set into the small slit in the wall of the knob.

5.10.2 PULSE AMPLITUDE-OFFSET Controls.

Removal. To remove the controls:

a. Set the controls full ccw.

b. Hold the instrument securely and pull the small knob off with the fingers.

NOTE

Do not lose the retention spring in the knob when the knob is removed.

c. Remove the setscrew from the bushing; use a hex-socket key wrench.

d. Remove the bushing. If the bushing comes off with the knob when the knob is removed, refer to the note in paragraph 5.10.1 for details on how to remove the bushing from the knob.

e. Again, holding the instrument firmly, pull the large knob off with the fingers. Do not lose the retention spring in the knob.

f. If the dual potentiometer behind the panel is to be removed, remove the setscrew from the next bushing and remove the bushing and the exposed dress nut.

Replacement. To replace the controls:

a. Make sure the shafts are turned full ccw.

b. Reverse the removal procedures, making sure the dial markings are at the bottom, slightly ccw from the first line of the scale (-1 on the offset scale).

CAUTION

Make sure the knobs are replaced with the retention spring opposite the setscrew. This may necessitate a 180° reversal of the bushing on the shaft. Also make sure the bushing for the small knob does not have the shaft protruding through the bushing, otherwise the knob won't set properly.

5.11 LAMP-REPLACEMENT PROCEDURE.

To replace the burnt-out > DUTY RATIO or pilot lamp, slide the metal clip of the back of the lamp holder and remove the lamp. Insert a new lamp (Chicago Miniature Lamp Works, No. 327 and No. 330 for pilot light and > DUTY RATIO lamp, respectively) and replace the clip.

5.12 FRONT-PANEL FINISH.

If the front panel is marred or scratched, retouch, if desired, with a light gray color, conforming with Federal Standards 595 (gray, 26492).

Parts Lists and Diagrams—Section 6

6.1 GENERAL 6-1

6.1 GENERAL.

This section contains the replaceable-parts lists, schematics, and etched-board layout. The Federal manufacture's code numbers in the parts lists are identified in the "Federal Manufacturers Code" listing. Figure 6-1 shows a front view of the Type 1340, identifying parts. Figure 5-6 shows an interior view, identifying parts.

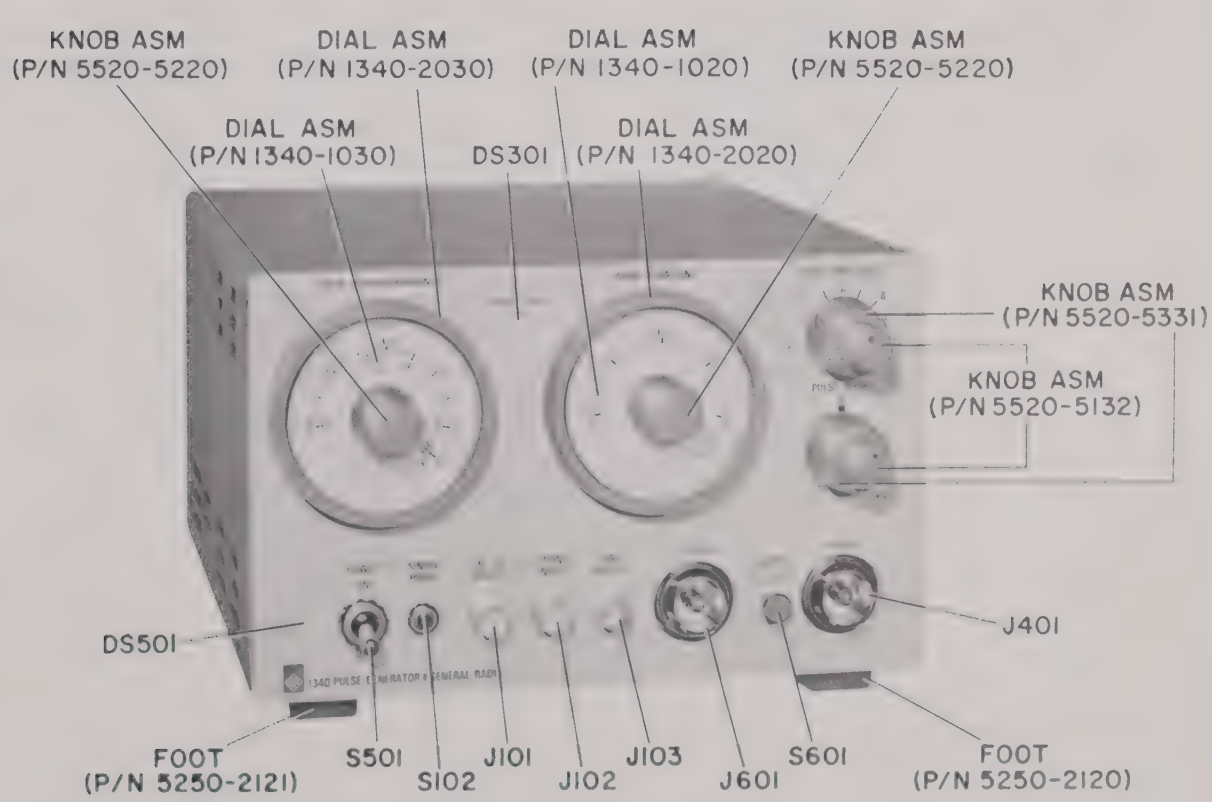


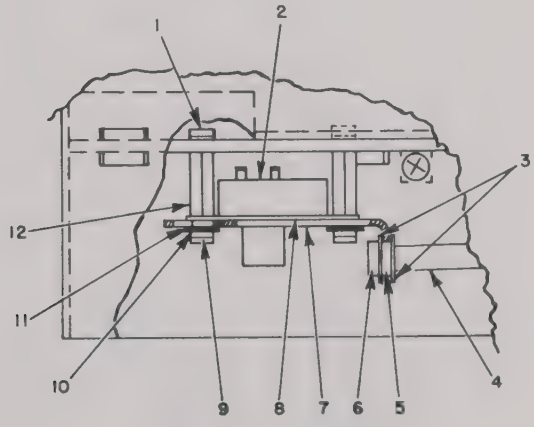
Figure 6-1. Front view of the 1340 Pulse Generator.

MECHANICAL REPLACEABLE PARTS

Name	Description	GR Part No.	FMC	Mfg. Part No.	Federal Stock No.
Knob Assembly	Knob, PULSE PERIOD/FREQUENCY, including retainer 5220-5402	5520-5220	24655	5520-5220	
Dial Assembly	Dial, PULSE PERIOD/FREQUENCY, including Hub Assembly 5420-2051	1340-1030	24655	1340-1030	
Dial Ring	Ring Dial, PULSE PERIOD/FREQUENCY range selector	1340-2030	24655	1340-2030	
Dial Ring	Ring Dial, PULSE DURATION range selector	1340-2020	24655	1340-2020	
Dial Assembly	Dial, PULSE DURATION, including Hub Assembly 5420-2051	1340-1020	24655	1340-1020	
Knob Assembly	Knob, PULSE DURATION, including retainer 5220-5403	5520-5132	24655	5520-5132	
Knob Assembly	Knob, PULSE AMPLITUDE, including retainer 5220-5402	5520-5331	24655	5520-5331	
Knob Assembly	Knob, PULSE AMPLITUDE, including retainer 5220-5403	5520-5132	24655	5520-5132	
Knob Assembly	Knob, PULSE OFFSET, including retainer 5220-5402	5520-5331	24655	5520-5331	
Knob Assembly	Knob, PULSE OFFSET, including retainer 5220-5403	5520-5132	24655	5520-5132	
Jack (J401)	Cable Connector, +PULSE	0874-4624	24655	0874-4624	
Jack (J601)	Cable Connector, -PULSE	0874-4624	24655	0874-4624	
Jack (J101, J102, J103)	Coaxial Jack, SYNC OUTPUT, GATING INPUT, EXT PRF SOURCE (respectively)	4230-2301	09408	UG-109A/U	
Switch	Pushbutton Switch, SINGLE PULSE	7870-1119	81073	30-2 N.C.	
Dress Nut (S102)	Nut 1/4-32, 5/16	5800-0820	24655	5800-0820	
Dress Nut (S501)	Nut, 15/32-32, 7/16	5800-0800	24655	5800-0800	5310-344-3634
Fuseholders	Fuse Mounting Device	5650-0100	71400	HKP-H	5920-284-7144
Bail	Instrument Support Tilt Bar	5250-2123	24655	5250-2123	
Foot	Rear, Black Neoprene Foot	5260-2060	24655	5260-2060	
Foot	Right, Black Phenolic Foot for use with bail	5250-2121	24655	5250-2121	
Foot	Left, Black Phenolic Foot for use with bail	5250-2120	24655	5250-2120	

MECHANICAL REPLACEABLE PARTS (CONT'D)

Fig. Ref. No.	Name	Description	Qty.	GR Part No.	Fed. Mfg. Code	Mfg. Part No.	Fed. Stock No.
	Switch Assembly (See Fig.)	Push-Pull, SOURCE, impedance selector	1				
1	Screw	Screw	2	7090-4040	24655	7090-4040	5305-993-8390
2	Switch	S601	1	7910-0773	76854	#76	
3	Washer	Washer	2	8100-1115	24655	8100-1115	
4	Shaft	Shaft	1	1340-6000	24655	1340-6000	
5	Spacer	Spacer	1	7650-0200	24655	7650-0200	
6	Screw	Screw	1	7070-1100	24655	7070-1100	5305-069-3435
7	Bracket	Bracket	1	1340-8500	24655	1340-8500	
8	Washer	Washer	1	8040-1800	96906	MS35 338-79	5310-011-1041
91	Screw	Screw	2	7090-4050	24655	7090-4050	5305-993-0645
10	Washer	Washer	2	8070-0500	24655	8070-0500	
11	Spacer	Spacer	2	7640-0300	24655	7640-0300	
12	Spacer	Spacer	2	7690-0500	24655	7690-0500	
—	Knob (front panel)	Knob, nickel plate	1	1340-6100	24655	1340-6100	



Side view of the SOURCE switch control at bottom rear of the instrument. 1340-56

FEDERAL MANUFACTURER'S CODE

From Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) as supplemented through August, 1968.

Code	Manufacturer
00192	Jones Mfg. Co, Chicago, Illinois
00194	Walsco Electronics Corp, L.A., Calif.
00434	Schweber Electronics, Westburg, L.I., N.Y.
00656	Aerovox Corp, New Bedford, Mass.
01009	Alden Products Co, Brockton, Mass.
01121	Allen-Bradley, Co, Milwaukee, Wisc.
01295	Texas Instruments, Inc, Dallas, Texas
02114	Ferroxcube Corp, Saugerties, N.Y. 12477
02606	Fenwal Lab Inc, Morton Grove, Ill.
02660	Amphenol Electron Corp, Broadview, Ill.
02768	Fastex, Des Plaines, Ill. 60016
03508	G.E. Semicon Prod, Syracuse, N.Y. 13201
03636	Grayburne, Yonkers, N.Y. 10701
03568	Pyrofilm Resistor Co, Cedar Knolls, N.J.
03911	Clairex Corp, New York, N.Y. 10001
04009	Arrow-Hart & Hegeman, Hartford, Conn. 06106
04713	Motorola, Phoenix, Ariz. 85008
05170	Engr'd Electronics, Santa Ana, Calif. 92702
05624	Barber-Colman Co, Rockford, Ill. 61101
05820	Wakefield Eng, Inc, Wakefield, Mass. 01880
07126	Digitron Co, Pasadena, Calif.
07127	Eagle Signal (E.W. Bliss Co), Baraboo, Wisc.
07261	Avnet Corp, Culver City, Calif. 90230
07263	Fairchild Camera, Mountain View, Calif.
07387	Birtcher Corp, No. Los Angeles, Calif.
07595	Amer Semicond, Arlington Hts, Ill. 60004
07828	Bodine Corp, Bridgeport, Conn. 06605
07829	Bodine Electric Co, Chicago, Ill. 60618
07910	Cont Device Corp, Hawthorne, Calif.
07983	State Labs Inc, N.Y., N.Y. 10003
07999	Borg Inst., Delavan, Wisc. 53115
08730	Vemaline Prod Co, Franklin Lakes, N.J.
09213	G.E. Semiconductor, Buffalo, N.Y.
09408	Star-Tronics Inc, Georgetown, Mass. 01830
09823	Burgess Battery Co, Freeport, Ill.
09922	Burndy Corp, Norwalk, Conn. 06852
11236	C.T.S. of Berne, Inc, Berne, Ind. 46711
11599	Chandler Evans Corp, W. Hartford, Conn.
12040	National Semiconductor, Danbury, Conn.
12498	Crystalonics, Cambridge, Mass. 02140
12672	RCA, Woodbridge, N.J.
12697	Clarostat Mfg Co, Inc, Dover, N.H. 03820
12954	Dickson Electronics, Scottsdale, Ariz.
13327	Solitron Devices, Tappan, N.Y. 10983
14433	ITT Semicondictors, W.Palm Beach, Fla.
14655	Cornell-Dubilier Electric Co, Newark, N.J.
14674	Corning Glass Works, Corning, N.Y.
14936	General Instrument Corp, Hicksville, N.Y.
15238	ITT, Semiconductor Div, Lawrence, Mass.
15605	Cutlet-Hammer Inc, Milwaukee, Wisc. 53233
16037	Spruce Pine Mica Co, Spruce Pine, N.C.
17771	Singer Co, Diehl Div, Somerville, N.J.
19396	Illinois Tool Works, Pakton Div, Chicago, Ill.
19644	LRC Electronics, Horseheads, N.Y.
19701	Electra Mfg Co, Independence, Kansas 67301
21335	Fafnir Bearing Co, New Briton, Conn.
22753	UID Electronics Corp, Hollywood, Fla.
23342	Avnet Electronics Corp, Franklin Park, Ill.
24446	G.E., Schenectady, N.Y. 12305
24454	G.E., Electronics Comp, Syracuse, N.Y.
24455	G.E. (Lamp Div), Nela Park, Cleveland, Ohio
24655	General Radio Co, W. Concord, Mass. 01781
26806	American Zettlet Inc, Costa Mesa, Calif.
28520	Hayman Mfg Co, Kenilworth, N.J.
28959	Hoffman Electronics Corp, El Monte, Calif.
30874	I.B.M, Armonk, New York
32001	Jensen Mfg. Co, Chicago, Ill. 60638
33173	G.E. Comp, Owensboro, Ky. 42301
35929	Constanta Co, Mont. 19, Que.
37942	P.R. Mallory & Co Inc, Indianapolis, Ind.
38443	Marlin-Rockwell Corp, Jamestown, N.Y.
40931	Honeywell Inc, Minneapolis, Minn. 55408
42190	Muter Co, Chicago, Ill. 60638
42498	National Co, Inc, Melrose, Mass. 02176
43991	Norma-Hoffman, Stanford, Conn. 06904
49671	RCA, New York, N.Y. 10020
49956	Raytheon Mfg Co, Waltham, Mass. 02154
53021	Sangamo Electric Co, Springfield, Ill. 62705
54294	Shallcross Mfg Co, Selma, N.C.
54715	Shure Brothers, Inc, Evanston, Ill.
56289	Sprague Electric Co, N. Adams, Mass.
59730	Thomas and Betts Co, Elizabeth, N.J. 07207
59875	TRW Inc, (Accessories Div), Cleveland, Ohio
60399	Torrington Mfg Co, Torrington, Conn.
61637	Union Carbide Corp, New York, N.Y. 10017
61864	United-Carr Fastener Corp, Boston, Mass.
63060	Victoreen Instrument Co, Inc, Cleveland, O.
63743	Ward Leonard Electric Co, Mt. Vernon, N.Y.
65083	Westinghouse (Lamp Div), Bloomfield, N.J.
65092	Weston Instruments, Newark, N.J.
70485	Atlantic-India Rubber, Chicago, Ill. 60607
70563	Amperite Co, Union City, N.J. 07087
70903	Belden Mfg Co, Chicago, Ill. 60644
71126	Bronson, Homer D, Co, Beacon Falls, Conn.
71294	Canfield, H.O. Co, Clifton Forge, Va. 24422
71400	Bussman (McGraw Edison), St. Louis, Mo.
71468	ITT Cannon Elec, L.A., Calif. 90031
71590	Centralab, Inc, Milwaukee, Wisc. 53212
71666	Continental Carbon Co, Inc, New York, N.Y.
71707	Coto Coil Co Inc, Providence, R.I.
71744	Chicago Miniature Lamp Works, Chicago, Ill.
71785	Cinch Mfg Co, Chicago, Ill. 60624
71823	Darnell Corp, Ltd, Downey, Calif. 90241
72136	Electro Motive Mfg Co, Wilmington, Conn.
72259	Nytronics Inc, Berkeley Heights, N.J. 07922
72619	Dialight Co, Brooklyn, N.Y. 11237
72699	General Instr Corp, Newark, N.J. 07104
72765	Drake Mfg Co, Chicago, Ill. 60656
72825	Hugh H. Eby Inc, Philadelphia, Penn. 19144
72962	Elastic Stop Nut Corp, Union, N.J. 07083
72982	Erie Technological Products Inc, Erie, Penn.
73138	Beckman Inc, Fullerton, Calif. 92634
73445	Amperex Electronics Co, Hicksville, N.Y.
73559	Carling Electric Co, W.Hartford, Conn.
73690	Elco Resistor Co, New York, N.Y.
73899	JFD Electronics Corp, Brooklyn, N.Y.
74193	Heinemann Electric Co, Trenton, N.J.
74861	Industrial Condenser Corp, Chicago, Ill.
74970	E.F. Johnson Co, Waseca, Minn. 56093
75042	IRC Inc, Philadelphia, Penn. 19108
75382	Kulka Electric Corp, Mt. Vernon, N.Y.
75491	Lafayette Industrial Electronics, Jamica, N.Y.
75608	Linden and Co, Providence, R.I.
75915	Littelfuse, Inc, Des Plaines, Ill. 60016
76005	Lord Mfg Co, Erie, Penn. 16512
76149	Mallory Electric Corp, Detroit, Mich. 48204
76487	James Millen Mfg Co, Malden, Mass. 02148
76545	Mueller Electric Co, Cleveland, Ohio 44114
76684	National Tube Co, Pittsburg, Penn.
76854	Oak Mfg Co, Crystal Lake, Ill.
77147	Patton MacGuyer Co, Providence, R.I.
77166	Pass-Seymour, Syracuse, N.Y.
77263	Pierce Roberts Rubber Co, Trenton, N.J.
77339	Positive Lockwasher Co, Newark, N.J.
77542	Ray-O-Vac Co, Madison, Wisc.
77630	TRW, Electronic Comp, Camden, N.J. 08103
77638	General Instruments Corp, Brooklyn, N.Y.
78189	Shakeproof (Ill. Tool Works), Elgin, Ill. 60120
78277	Sigma Instruments Inc, S.Braintree, Mass.
78488	Stackpole Carbon Co, St. Marys, Penn.
78553	Tinnerman Products, Inc, Cleveland, Ohio
79089	RCA, Rec Tube & Semicond, Harrison, N.J.
79725	Wiremold Co, Hartford, Conn. 06110
79963	Zierick Mfg Co, New Rochelle, N.Y.
80030	Prestole Fastener, Toledo, Ohio
80048	Vickers Inc, St. Louis, Mo.
80131	Electronic Industries Assoc, Washington, D.C.
80183	Sprague Products Co, No. Adams, Mass.
80211	Motorola Inc, Franklin Park, Ill. 60131
80258	Standard Oil Co, Lafeyette, Ind.
80294	Bourns Inc, Riverside, Calif. 92506
80431	Air Filter Corp, Milwaukee, Wisc. 53218
80583	Hammarlund Co, Inc, New York, N.Y.
80740	Beckman Instruments, Inc, Fullerton, Calif.
81030	International Insturment, Orange, Conn.
81073	Grayhill Inc, LaGrange, Ill. 60525
81143	Isolantite Mfg Corp, Stirling, N.J. 07980
81349	Military Specifications
81350	Joint Army-Navy Specifications
81751	Columbus Electronics Corp, Yonkers, N.Y.
81831	Filtron Co, Flushing, L.I., N.Y. 11354
81840	Ledex Inc, Dayton, Ohio 45402
81860	Barry-Wright Corp, Watertown, Mass.
82219	Sylvania Elec Prod, Emporium, Penn.
82273	Indiana Pattern & Model Works, LaPort, Ind.
82389	Switchcraft Inc, Chicago, Ill. 60630
82647	Metals & Controls Inc, Attleboro, Mass.
82807	Milwaukee Resistor Co, Milwaukee, Wisc.
83033	Meissner Mfg, (Maguire Ind) Mt. Carmel, Ill.
83058	Carr Fastener Co, Cambridge, Mass.
83186	Victory Engineering, Springfield, N.J. 07081
83361	Bearing Specialty Co, San Francisco, Calif.
83587	Solar Electric Corp, Warren, Penn.
83740	Union Carbide Corp, New York, N.Y. 10017
83781	National Electronics Inc, Geneva, Ill.
84411	TRW Capacitor Div, Ogallala, Nebr.
84835	Lehigh Metal Prods, Cambridge, Mass. 02140
84971	TA Mfg Corp, Los Angeles, Calif.
86577	Precision Metal Prods, Stoneham, Mass. 02180
86684	RCA (Elect. Comp & Dev), Harrison, N.J.
86687	REC Corp, New Rochelle, N.Y. 10801
86800	Cont Electronics Corp, Brooklyn, N.Y. 11222
88140	Cutler-Hammer Inc, Lincoln, Ill.
88219	Gould Nat. Batteries Inc, Trenton, N.J.
88419	Cornell-Dubilier, Fuquay-Varina, N.C.
88627	K & G Mfg Co, New York, N.Y.
89482	Holtzer-Cabot Corp, Boston, Mass.
89665	United Transformer Co, Chicago, Ill.
90201	Mallory Capacitor Co, Indianapolis, Ind.
90750	Westinghouse Electric Corp, Boston, Mass.
90952	Hardware Products Co, Reading, Penn. 19602
91032	Continental Wire Corp, York, Penn. 17405
91146	ITT (Cannon Electric Inc), Salem, Mass.
91293	Johanson Mfg Co, Boonton, N.J. 07005
91506	Augat Inc, Attleboro, Mass. 02703
91598	Chandler Co, Wethersfield, Conn. 06109
91637	Dale Electronics Inc, Columbus, Nebr.
91662	Elco Corp, Willow Grove, Penn.
91719	General Instruments, Inc, Dallas, Texas
91929	Honeywell Inc, Freeport, Ill.
92519	Electra Insul Corp, Woodside, L.I., N.Y.
92678	E.G.&G., Boston, Mass.
93332	Sylvania Elect Prods, Inc, Woburn, Mass.
93916	Cramer Products Co, New York, N.Y. 10013
94144	Raytheon Co, Components Div, Quincy, Mass.
94154	Tung Sol Electric Inc, Newark, N.J.
95076	Garde Mfg Co, Cumberland, R.I.
95121	Quality Components Inc, St. Mary's, Penn.
95146	Alco Electronics Mfg Co, Lawrence, Mass.
95238	Continental Connector Corp, Woodside, N.Y.
95275	Vitramon, Inc, Bridgeport, Conn.
95354	Methode Mfg Co, Chicago, Ill.
95412	General Electric Co, Schenectady, N.Y.
95794	Anaconda Amer Brass Co, Torrington, Conn.
96095	Hi-Q Div. of Aerovox Corp, Orlean, N.Y.
96214	Texas Instruments Inc, Dallas, Texas 75209
96256	Thordarson-Meissner, Mt. Carmel, Ill.
96341	Microwave Associates Inc, Burlington, Mass.
96791	Amphenol Corp, Jonesville, Wisc. 53545
99306	Military Standards
98291	Sealectro Corp, Mamaroneck, N.Y. 10544
98474	Compar Inc, Burlingame, Calif.
98821	North Hills Electronics Inc, Glen Cove, N.Y.
99180	Transitron Electronics Corp, Melrose, Mass.
99313	Varian, Palo Alto, Calif. 94303
99378	Atlee Corp, Winchester, Mass. 01890
99800	Delevan Electronics Corp, E. Aurora, N.Y.

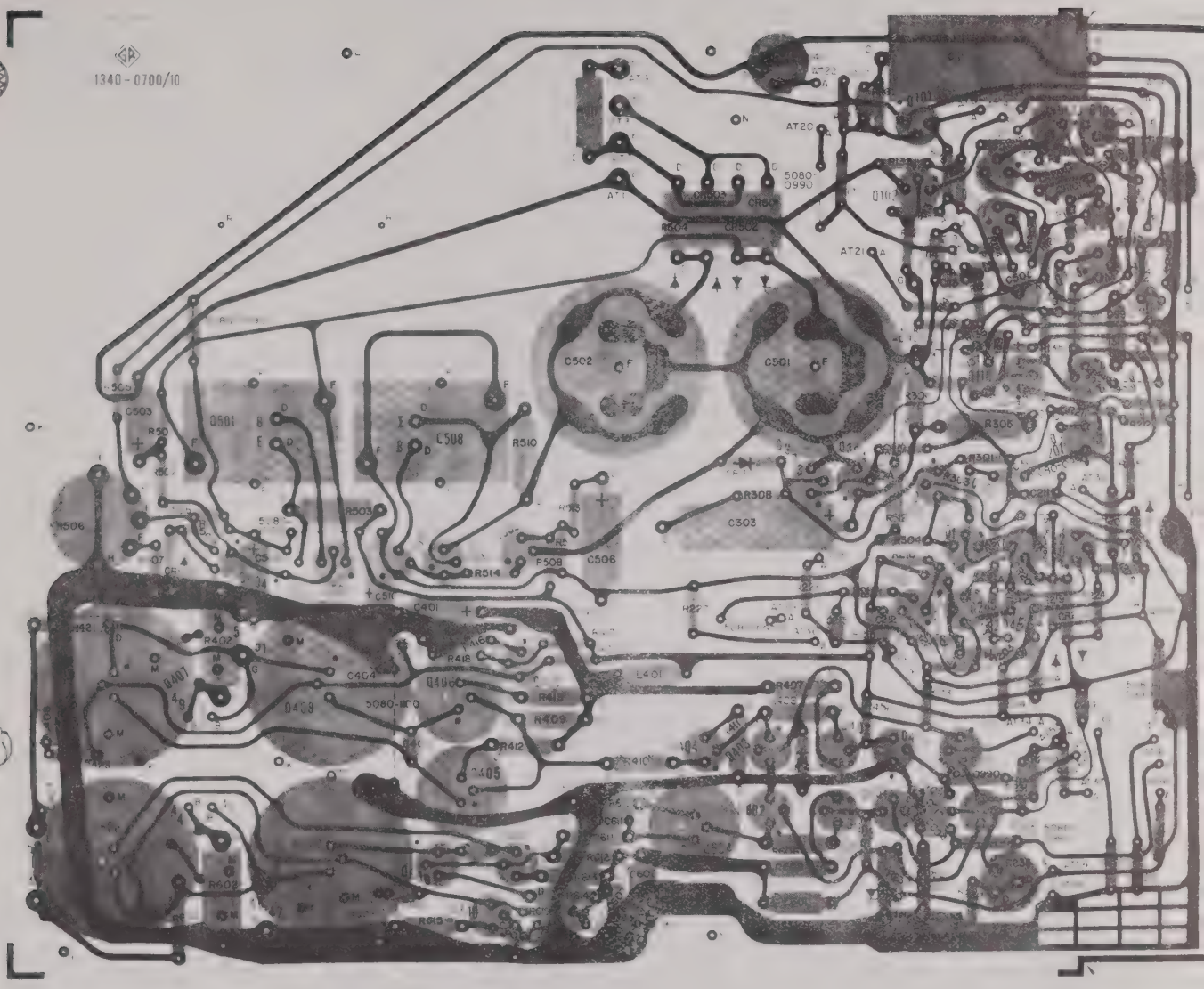
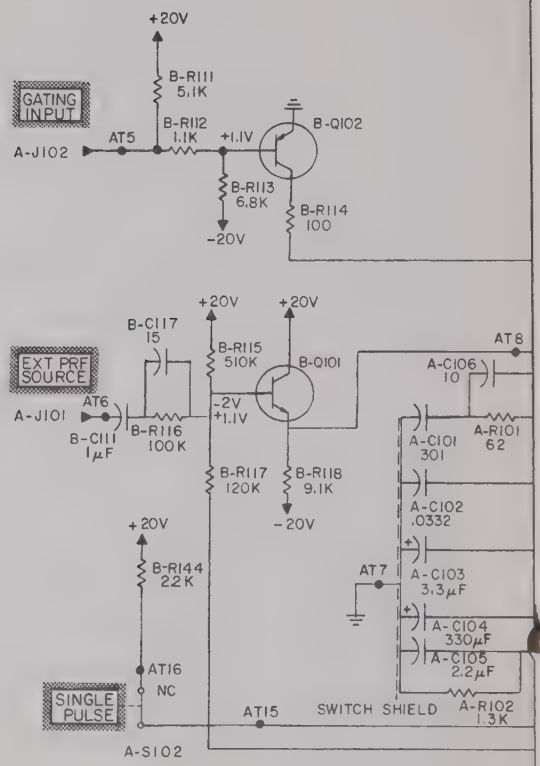


Figure 6-2. Etched-circuit board assembly (P/N 1340-2701).

NOTES

1. In units with identification numbers ID-B100 and ID-B826, S102 is normally open, and C116 is connected between S102 and R144 to ground. Refer to the replaceable-parts list for values of this and other parts in the single-pulse switch circuit of units with the above ID numbers.
2. Rotary switch sections are shown as viewed from the panel end of the shaft. The first digit of the contact number refers to the section. The section nearest the panel is 1, the next section back is 2, etc. The next two digits refer to the contact. Contact 01 is the first position clockwise from a strut screw (usually the screw above the locating key), and the other contacts are numbered sequentially (02, 03, 04, etc.), proceeding clockwise around the section. A suffix F or R indicates that the contact is on the front or rear of the section, respectively.
3. The number shown on the foil side of the board is not the part number for the complete assembly. This assembly is given in the caption.
4. The dot on the foil at the transistor socket indicates the collector lead.

DC VOLTAGES TAKEN WITH INSTRUMENT
SET FOR SINGLE PULSE – SQUARE WAVE, PRF VERNIER CCW
TWO VOLTAGES AT EACH POINT
TOP – PUSH SINGLE PULSE BUTTON
BOTTOM – SINGLE PULSE BUTTON NORMAL



EXT PRF

50 - 500 ns

0.5 - 5 μs

5 - 50 μs

50 - 500 μs

0.5 - 5 ms

5 - 50 ms

50 - 500 ms

0.5 - 5 s

SINGLE PULSE

A-R103
287
1/8W

A-R105
1.54K
1/8W

A-S101,10

-20

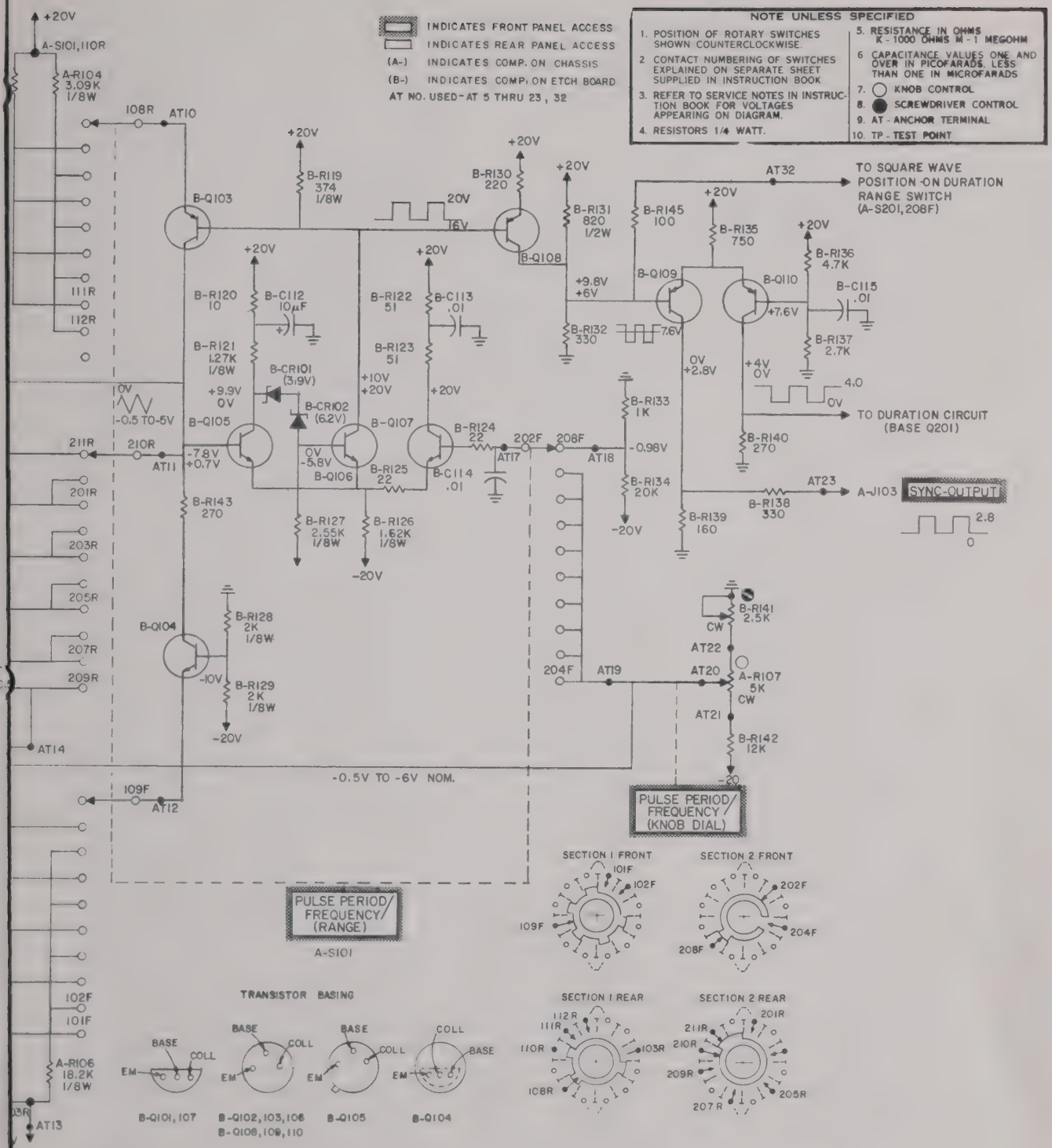


Figure 6-3. Pulse period/frequency generator schematic diagram.

Ref. Desig.	Description	GR Part No.	Fed. Mfg. Code	Mfg. Part No.	Fed. Stock No.
CAPACITORS:					
C101	Mica, 301pF ± 2% 300V	4650-0301	72136	CM 15E, 301 pF ± 2%	
C102	Plastic, .0332μF ± 10% 15V	4860-7868	84411	663UW, 0.0332μF ± 2%	
C103	Electrolytic, 3.3μF ± 10% 15V	4450-4601	56289	TT, 3.3μF ± 10%	
C104	Electrolytic, 330μF ± 10% 6V	4450-5708	56289	TT, 330μF ± 10%	
†C105	Ceramic, .01μF + 80-20% 50V	4401-3100	80131	CC61, 0.01μF + 80-20%	5910-974-5697
C105	Ceramic, 2.2μF ± 20% 25V	4400-2080	80131	5C13, 2.2μF ± 20%	
C106	Ceramic, 10pF ± 10% 500V	4404-0108	72982	831, 10pF ± 10%	
C111	Plastic, 1μF ± 10% 100V	4860-8274	84411	663UW, 1μF ± 10%	
C112	Ceramic, .01μF +80-20% 50V	4401-3100	80131	CC61, 0.01μF +80-20%	5910-974-5697
C113	Ceramic, .01μF +80-20% 50V	4401-3100	80131	CC61, 0.01μF +80-20%	5910-974-5697
C114	Ceramic, .01μF +80-20% 50V	4401-3100	80131	CC61, 0.01μF +80-20%	5910-974-5697
C115	Ceramic, .01μF +80-20% 50V	4401-3100	80131	CC61, 0.01μF +80-20%	5910-974-5697
†C116	Ceramic, .01μF +80-20% 50V	4401-3100	80131	CC61, 0.01μF +80-20%	5910-974-5697
C117	Ceramic, 15pF ± 10% 500V	4404-0158	72982	831, 15pF ± 10%	
C201	Mica, 301pF ± 2% 300V	4650-0301	72136	CM 15E, 301pF ± 2%	
C202	Plastic, .0332μF ± 2% 100V	4860-7868	84411	663UW, 0.0332μF ± 2%	
C203	Electrolytic, 3.3μF ± 10% 15V	4450-4601	56289	TT, 3.3μF ± 10%	
C204	Electrolytic, 330μF ± 10% 6V	4450-5708	56289	TT, 330μF	
C211	Ceramic, 27pF ± 10% 500V	4404-0278	72982	831, 27pF ± 10%	
C212	Ceramic, .01μF +80-20% 50V	4401-3100	80131	CC61, 0.01μF +80-20%	5910-974-5697
C213	Ceramic, .01μF +80-20% 50V	4401-3100	80131	CC61, 0.01μF +80-20%	5910-974-5697
C214	Ceramic, .01μF +80-20% 50V	4401-3100	80131	CC61, 0.01μF +80-20%	5910-974-5697
C217	Ceramic, .01μF +80-20% 50V	4401-3100	80131	CC61, 0.01μF +80-20%	5910-974-5697
C301	Ceramic, 27pF ± 10% 500V	4404-0278	72982	831, 27pF ± 10%	
C302	Ceramic, .01μF +80-20% 50V	4401-3100	80131	CC61, 0.01μF +80-20%	5910-974-5697
C303	Electrolytic, 25μF +150-10% 50V	4450-3000	56289	D33883	5910-799-9285
C401	Electrolytic, 15μF ± 20% 20V	4450-5200	56289	150D 156X0020B2	5910-855-6335
C402	Ceramic, 1μF ± 20% 25V	4400-2070	80183	5C13, 1μF ± 20%	5910-083-6445
C403	Ceramic, .01μF +80-20% 50V	4401-3100	80131	CC61, 0.01μF +80-20%	5910-974-5697
C404	Ceramic, .01μF +80-20% 50V	4401-3100	80131	CC61, 0.01μF +80-20%	5910-974-5697
C405	Ceramic, .01μF +80-20% 50V	4401-3100	80131	CC61, 0.01μF +80-20%	5910-974-5697
C407	Ceramic, .01μF +80-20% 50V	4401-3100	80131	CC61, 0.01μF +80-20%	5910-974-5697
C408	Ceramic, .01μF +80-20% 50V	4401-3100	80131	CC61, 0.01μF +80-20%	5910-974-5697
C501	Electrolytic, 2400μF 35V	4450-5610	37942	20-0000224700102	
C502	Electrolytic, 2400μF 35V	4450-5610	37942	20-0000224700102	
C503	Electrolytic, 6.8μF ± 20% 35V	4450-5000	56287	150D685X0035B2	5910-814-5869
C504	Ceramic, 0.47μF ± 20% 25V	4400-2054	80183	5C13, 0.47μF ± 20%	5910-974-5696
C505	Electrolytic, 10μF +100-10% 25V	4450-3800	56289	30D106G025BB4M1	5910-952-8658
C506	Electrolytic, 10μF +100-10% 25V	4450-3800	56289	30D106G025BB4M1	5910-952-8658
C507	Ceramic, 0.47μF ± 20% 25V	4400-2054	80183	5C13, 0.47μF ± 20%	5910-974-5696
*C508	Ceramic, 220pF +80-20% 500V	4404-1229	72982	831, 220pF +80-20%	5910-952-8404
C508	Ceramic, 100pF +80-20% 500V	4404-1109	72982	831, 100pF +80-20%	
C509	Electrolytic, 6.8μF ± 20% 35V	4450-5000	56289	150D685X0035B2	5910-814-5869

*Denotes component in early production units with identification No. ID-B100.

†Denotes component only in units with ID Nos. ID-B100 and ID-B826.

ELECTRICAL REPLACEABLE PARTS (CONT'D)

Ref. Desig.	Description	GR Part No.	Fed Mfg. Code	Mfg. Part No.	Fed. Stock No.
CAPACITORS (Cont'd)					
C510	Electrolytic, 6.8μF ± 20% 35V	4450-5000	56285	150D685X0035B2	5910-814-5869
C602	Ceramic, .01μF +80-20% 50V	4401-3100	60131	CC61, 0.01μF +80-20%	5910-974-5697
C603	Ceramic, .01μF +80-20% 50V	4401-3100	80131	CC61, 0.01μF +80-20%	5910-974-5697
C604	Ceramic, .01μF +80-20% 50V	4401-3100	80131	CC61, 0.01μF +80-20%	5910-974-5697
C605	Ceramic, .01μF +80-20% 50V	4401-3100	80131	CC61, 0.01μF +80-20%	5910-974-5697
C606	Electrolytic, 15μF ± 20% 20V	4450-5200	56289	150D156X0020B2	5910-855-6335
C607	Ceramic, 1μF ± 20% 25V	4400-2070	80183	5C13, 1μF ± 20%	5910-083-6445
C609	Ceramic, .01μF +80-20% 50V	4401-3100	80131	CC61, 0.01μF +80-20%	5910-974-5697
C610	Ceramic, .01μF +80-20% 50V	4401-3100	80131	CC61, 0.01μF +80-20%	5910-974-5697
C611	Ceramic, 4.7pF ± 5% 500V	4411-9475	24655	4411-9475	
DIODES:					
CR101	Type 1N748A	6083-1002	07910	1N748A	5960-800-3973
CR102	Type 1N753A	6083-1006	07910	1N753A	5961-752-6121
CR201	Type 1N3604	6082-1001	24446	1N3604	5961-995-2199
CR202	Type 1N4009	6082-1001	24446	1N3604	5961-995-2199
CR203	Type 1N758A	6083-1012	07910	1N758A	
CR204	Type 1N995	6082-1002	80368	1N995	
CR205	Type 1N959B	6083-1010	72699	1N959B	
CR301	Type 1N3604	6082-1001	24446	1N3604	5961-995-2199
CR403	Type 1N3604	6082-1001	24446	1N3604	5961-995-2199
CR501	Type 1N3253	6081-1001	79089	1N3253	5961-814-4251
CR502	Type 1N3253	6081-1001	79089	1N3253	5961-814-4251
CR503	Type 1N3253	6081-1001	79089	1N3253	5961-814-4251
CR504	Type 1N3253	6081-1001	79089	1N3253	5961-814-4251
CR505	Type 1N957B	6083-1009	07910	1N957B	
CR603	Type 1N3604	6082-1001	24446	1N3604	5960-995-2199
LAMPS:					
DS301	Duty Ratio	5600-0309	71744	#330	
DS501	Pilot Light	5600-0307	71744	#327	
FUSES:					
F501	Slo-Blo 4/10	5330-0900	71400	MDL, 0.4 Amp.	5920-537-6654
F502	Slo-Blo 2/10	5330-0600	71400	MDL, 0.2 Amp.	
JACKS:					
J101	BNC, Ext. PRF Source	4230-2301	09408	UG-1094A/U	
J102	BNC, Gating Input	4230-2301	09408	UG-1094A/U	
J103	BNC, Sync Output	4230-2301	09408	UG-1094A/U	
J401	+ Pulse	0874-4624	24655	0874-4624	
J501	Connector, Power Plug	4240-0600	24655	4240-0600	5935-816-0254
J601	Pulse	0874-4624	24655	0874-4624	

Ref. Desig.	Description	GR Part No.	Fed. Mfg. Code	Mfg. Part No.	Fed. Stock No.
INDUCTORS:					
L401	Choke, Molded, 2.2μH ± 10%	4300-1200	99800	1537-20, 2.2μH ± 10%	
L601	Choke, Molded, 2.2μH ± 10%	4300-1200	99800	1537-20, 2.2μH ± 10%	
TRANSISTORS:					
Q101	Type 2N4124	8210-1154	93916	2N4124	
Q102	Type 2N4258	8210-1136	93916	2N4258	
Q103	Type 2N4121	8210-1151	07263	2N4121	
Q104	Type 2N3391A	8210-1092	24454	2N3391A	
Q105	Type 2N3227	8210-1134	04713	2N3227	
Q106	Type 2N3563	8210-1066	07263	2N3563	
Q107	Type 2N3903	8210-1132	93916	2N3903	
Q108	Type 2N4258	8210-1136	93916	2N4258	
Q109	Type 2N4258	8210-1136	93916	2N4258	
Q110	Type 2N4258	8210-1136	93916	2N4258	
Q201	Type 2N3563	8210-1066	07263	2N3563	
Q202	Type 2N4258	8210-1136	93916	2N4258	
Q203	Type 2N3391A	8210-1092	24454	2N3391A	
Q204	Type 2N3227	8210-1134	04713	2N3227	
Q205	Type 2N3563	8210-1066	07263	2N3563	
Q206	Type 2N3903	8210-1132	93916	2N3903	
Q207	Type 2N4258	8210-1136	93916	2N4258	
Q208	Type 2N4258	8210-1136	93916	2N4258	
Q209	Type 2N4121	8210-1151	07263	2N4121	
††Q301	Type 2N4275	8210-1126	23342	2N4275	
Q301	Type 2N3903	8210-1132	93916	2N3903	
Q302	Type 2N4275	8210-1126	23342	2N4275	
Q303	Type 2N4275	8210-1126	23342	2N4275	
Q304	Type 2N4123	8210-1123	23342	2N4275	
Q401	Type 2N4125	8210-1125	93916	2N4125	
Q402	Type 2N2218	8210-1028	81349	2N2218	5960-059-4464
Q403	Type 2N3227	8210-1134	04713	2N3227	
Q404	Type 2N3866	8210-1120	93916	2N3866	
Q405	Type 2N4258	8210-1136	93916	2N4258	
Q406	Type 2N4258	8210-1136	93916	2N4258	
Q407	Type 2N2904	8210-1074	93916	2N2904	
Q408	Type 2N2904	8210-1074	93916	2N2904	
Q409	Type 2N4125	8210-1125	93916	2N4125	
Q501	Type 40250V1	8210-1158	12672	40250-V1	
Q502	Type 2N3414	8210-1047	24446	2N3414	5961-989-2749
Q503	Type 2N3903	8210-1132	93916	2N3903	5961-989-2749
Q504	Type 2N3414	8210-1047	93916	2N3903	5961-989-2749
Q505	Type 2N3905	8210-1114	04713	2N3905	5961-989-2749

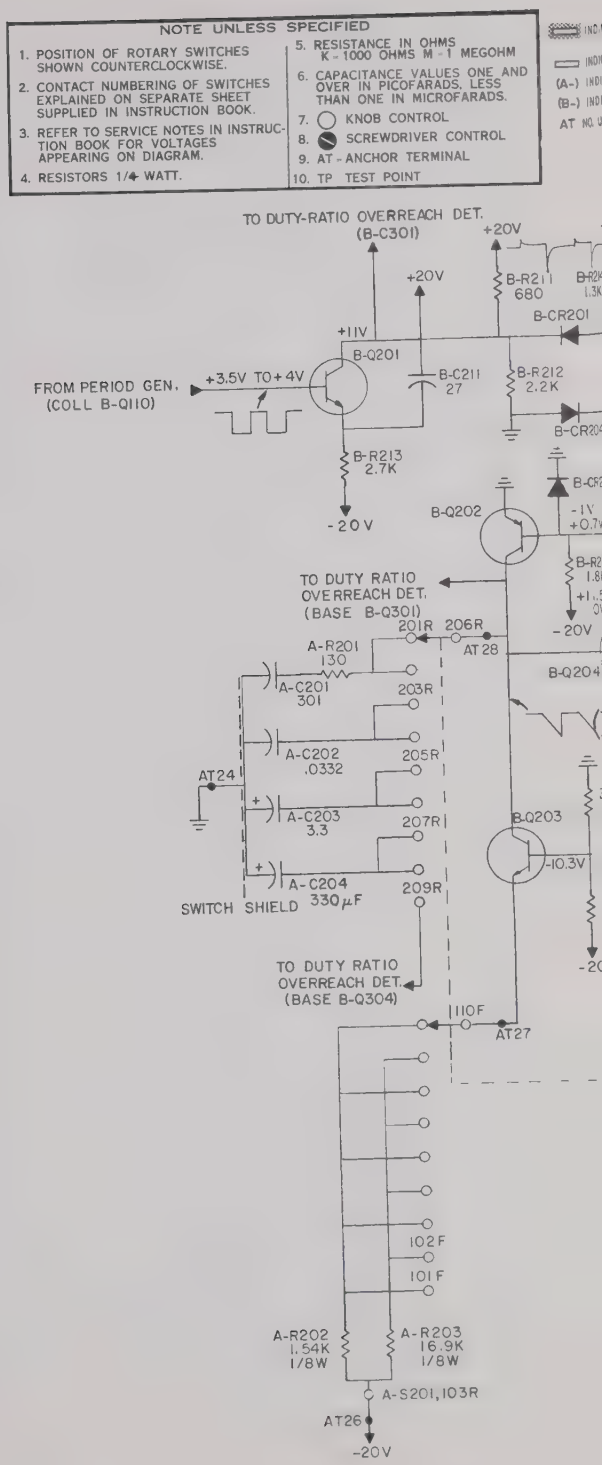
††Denotes component only in units with ID Nos. ID-B100, B826, & B848.

Ref. Desig.	Description	GR Part No.	Fed. Mfg. Code	Mfg. Part No.	Fed. Stock No.
TRANSISTORS (Cont'd)					
Q506	Type 2N3903	8210-1132	93916	2N3903	
Q507	Type 2N3414	8210-1047	24446	2N3414	5961-989-2749
Q508	Type 40250V1	8210-1158	12672	40250-V1	
Q601	Type 2N4123	8210-1123	93916	2N4123	
Q602	Type 2N4258	8210-1136	93916	2N4258	
Q603	Type 2N3250	8210-1089	80211	2N3250	
Q604	Type 2N3250	8210-1089	80211	2N3250	
Q606	Type 2N2218	8210-1028	81349	2N2218	5960-059-4464
Q607	Type 2N2218	8210-1028	81349	2N2218	5960-059-4464
Q608	Type 2N4427	8210-1159	12672	2N4427	
Q609	Type 2N4427	8210-1159	12672	2N4427	
Q610	Type 2N4275	8210-1126	23342	2N4275	
RESISTORS:					
R101	Composition, 62Ω ± 5% 1/4W	6099-0625	75042	BTS, 62Ω ± 5%	
*R102	Composition, 1KΩ ± 10% 1/4W	6099-2109	75042	BTS, 1KΩ ± 10%	
R102	Composition, 1.3KΩ ± 5% 1/4W	6099-2135	75042	BTS, 1.3KΩ ± 5%	
R103	Film, 287Ω ± 1% 1/8W	6250-0287	75042	CEA, 287Ω ± 1%	
R104	Film, 3.09Ω ± 1% 1/8W	6250-1309	75042	CEA, 3.09KΩ ± 1%	
R105	Film, 1.54KΩ ± 1% 1/8W	6250-1154	75042	CEA, 1.54KΩ ± 1%	
*R106	Composition, 16.9KΩ ± 1% 1/8W	6250-2169	75042	CEA, 16.9KΩ ± 1%	5905-806-8487
R106	Composition, 18.2KΩ ± 1% 1/8W	6250-2182	75042	CEA, 18.2KΩ ± 1%	5905-686-3373
R107	Pot, Comp., 5KΩ ± 10%	6000-0500	01121	JU, 5KΩ ± 10%	
R111	Composition, 5.1KΩ ± 5% 1/4W	6099-2515	75042	BTS, 5.1KΩ ± 5%	5905-279-4623
R112	Composition, 1.1KΩ ± 5% 1/4W	6099-2115	75042	BTS, 1.1KΩ ± 5%	
R113	Composition, 6.8KΩ ± 10% 1/4W	6099-2689	75042	BTS, 6.8KΩ ± 10%	
R114	Composition, 100Ω ± 10% 1/4W	6099-1109	75042	BTS, 100Ω ± 10%	
R115	Composition, 510KΩ ± 5% 1/4W	6099-4515	75042	BTS, 510KΩ ± 5%	
R116	Composition, 100KΩ ± 10% 1/4W	6099-4109	75042	BTS, 100KΩ ± 10%	
R117	Composition, 120KΩ ± 5% 1/4W	6099-4125	75042	BTS, 120KΩ ± 5%	
R118	Composition, 9.1KΩ ± 5% 1/4W	6099-2915	75042	BTS, 9.1KΩ ± 5%	5905-279-4619
R119	Film, 374KΩ ± 1% 1/8W	6250-0374	75042	CEA, 374KΩ ± 1%	
R120	Composition, 10Ω ± 10% 1/4W	6099-0109	75042	BTS, 10Ω ± 10%	
R121	Film, 1.27KΩ ± 1% 1/8W	6250-1127	75042	CEA, 1.27KΩ ± 1%	5905-721-0281
R122	Composition, 51Ω ± 5% 1/4W	6099-0515	75042	BTS, 51Ω ± 5%	
R123	Composition, 51Ω ± 5% 1/4W	6099-0515	75042	BTS, 51Ω ± 5%	
R124	Composition, 22Ω ± 10% 1/4W	6099-0229	75042	BTS, 22Ω ± 10%	
R125	Composition, 22Ω ± 10% 1/4W	6099-0229	75042	BTS, 22Ω ± 10%	
R126	Film, 1.62KΩ ± 1% 1/8W	6250-1162	75042	CEA, 1.62KΩ ± 1%	5905-702-1144
R127	Film, 2.55KΩ ± 1% 1/8W	6250-1255	75042	CEA, 2.55KΩ ± 1%	
R128	Film, 2KΩ ± 1% 1/8W	6250-1200	75042	CEA, 2KΩ ± 1%	5905-577-6614
R129	Film, 2KΩ ± 1% 1/8W	6250-1200	75042	CEA, 2KΩ ± 1%	5905-577-6614
R130	Composition, 220Ω ± 5% 1/4W	6099-1225	75042	BTS, 220Ω ± 5%	5905-683-2240
R131	Composition, 820Ω ± 5% 1/4W	6099-1825	75042	BTS, 820Ω ± 5%	

*Denotes component in early production units with identification No. ID-B100.

NOTE

Rotary switch sections are shown as viewed from the panel end of the shaft. The first digit of the contact number refers to the section. The section nearest the panel is 1, the next section back is 2, etc. The next two digits refer to the contact. Contact 01 is the first position clockwise from a strut screw (usually the screw above the locating key), and the other contacts are numbered sequentially (02, 03, 04, etc), proceeding clockwise around the section. A suffix F or R indicates that the contact is on the front or rear of the section, respectively.



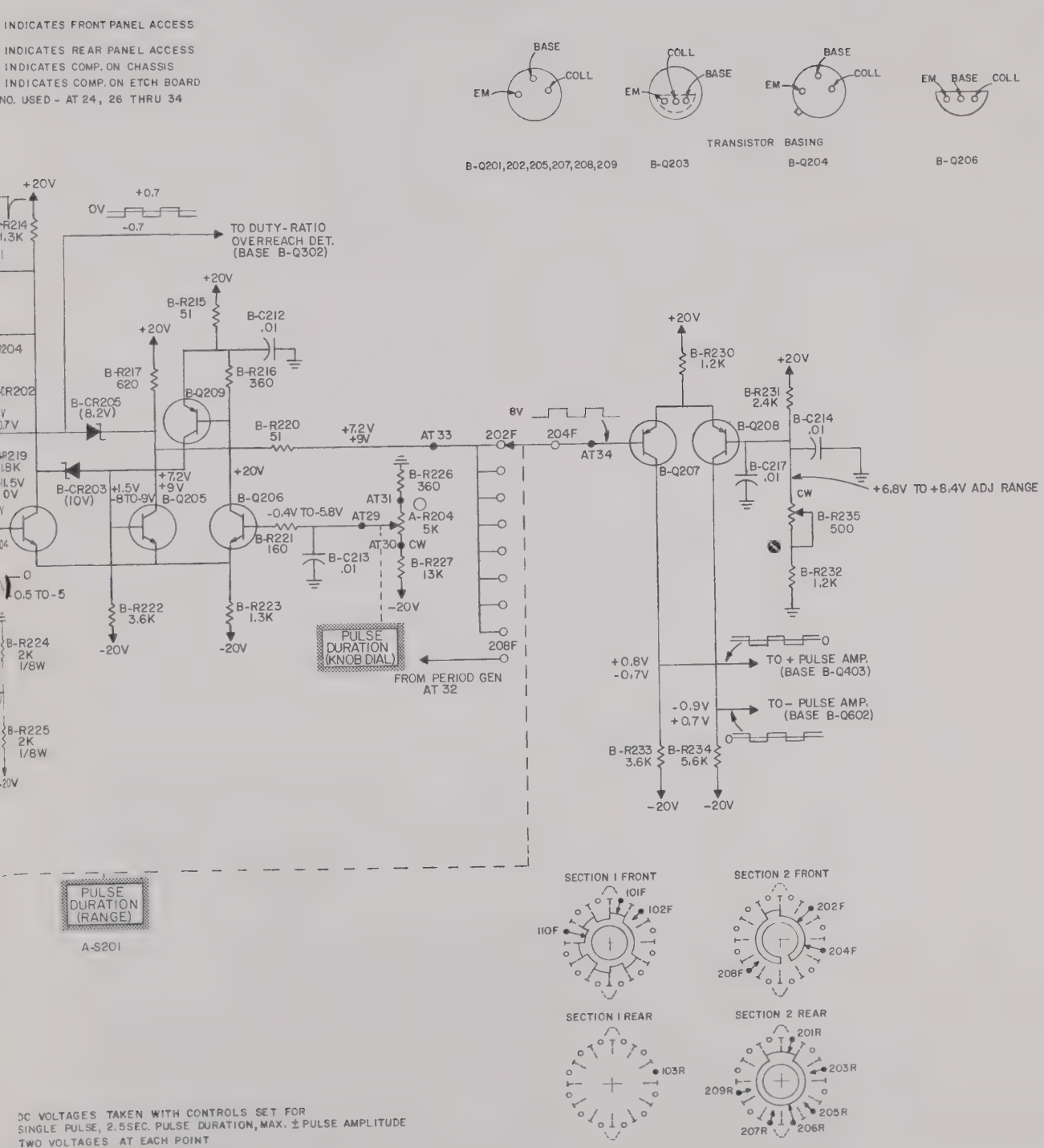


Figure 6-4. Pulse duration generator schematic diagram.

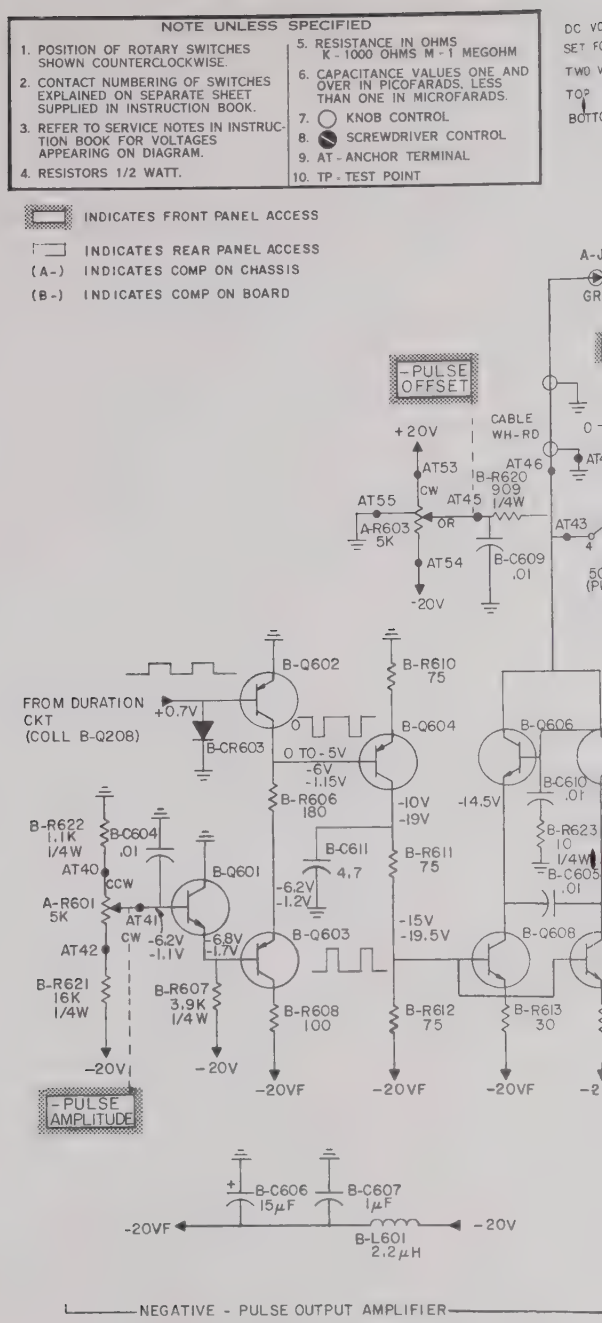
Ref. Desig.	Description	GR Part No.	Fed. Mfg. Code	Mfg. Part No.	Fed. Stock No.
RESISTORS (Cont'd)					
R132	Composition, 330Ω ± 5% 1/4W	6099-1335	75042	BTS, 330Ω ± 5%	5905-686-3369
R133	Composition, 1KΩ ± 5% 1/4W	6099-2105	75042	BTS, 1KΩ ± 5%	
R134	Composition, 20KΩ ± 5% 1/4W	6099-3205	75042	BTS, 20KΩ ± 5%	
R135	Composition, 750Ω ± 5% 1/4W	6099-1755	75042	BTS, 750Ω ± 5%	
R136	Composition, 4.7KΩ ± 5% 1/4W	6099-2475	75042	BTS, 2.7KΩ ± 5%	
R137	Composition, 2.7KΩ ± 5% 1/4W	6099-2275	75042	BTS, 2.7KΩ ± 5%	
R138	Composition, 330Ω ± 5% 1/4W	6099-1335	75042	BTS, 330Ω ± 5%	
R139	Composition, 160Ω ± 5% 1/4W	6099-1165	75042	BTS, 160Ω ± 5%	
R140	Composition, 270Ω ± 5% 1/4W	6099-1275			
R141	Pot, Comp., 2.5KΩ ± 20% 1/4W	6040-0500	01121	FWC, 2.5KΩ ± 20%	5905-931-6868
R142	Composition, 12KΩ ± 5% 1/4W	6099-3125	75042	BTS, 12KΩ ± 5%	
R143	Composition, 270Ω ± 5% 1/4W	6099-1275	75042	BTS, 270Ω ± 5%	
†R144	Composition, 10MΩ ± 10% 1/4W	6099-6109	75042	BTS, 10MΩ ± 10%	
R144	Composition, 2.2KΩ ± 5% 1/4W	6099-2225	75042	BTS, 2.2KΩ ± 5%	5905-723-5251
R145	Composition, 100Ω ± 10% 1/4W	6099-1109	75042	BTS, 100Ω ± 10%	
R201	Composition, 130Ω ± 5% 1/4W	6099-1135	75042	BTS, 130Ω ± 5%	5905-686-3369
R202	Film, 1.54KΩ ± 1% 1/8W	6250-1154	75042	CEA, 1.54KΩ ± 1%	
R203	Film, 16.9KΩ ± 1% 1/8W	6250-2169	75042	CEA, 16.9KΩ ± 1%	
R204	Pot, Comp., 5KΩ ± 10%	6000-0500	01121	JU, 5KΩ ± 10%	
R211	Composition, 680Ω ± 5% 1/4W	6099-1685	75042	BTS, 680Ω ± 5%	
R212	Composition, 2.2KΩ ± 5% 1/4W	6099-2225	75042	BTS, 2.2KΩ ± 5%	
R213	Composition, 2.7KΩ ± 5% 1/4W	6099-2275	75042	BTS, 2.7KΩ ± 5%	
R214	Composition, 1.3KΩ ± 5% 1/4W	6099-2135	75042	BTS, 1.3KΩ ± 5%	5905-686-3119
R215	Composition, 51Ω ± 5% 1/4W	6099-0515	75042	BTS, 51Ω ± 5%	
R216	Composition, 360Ω ± 5% 1/4W	6099-1365	75042	BTS, 360Ω ± 5%	
R217	Composition, 620Ω ± 5% 1/4W	6099-1625	75042	BTS, 620Ω ± 5%	5905-801-6998
R219	Composition, 1.8KΩ ± 5% 1/4W	6099-2185	75042	BTS, 1.8KΩ ± 5%	5905-688-3738
R220	Composition, 51Ω ± 5% 1/4W	6099-0515	75042	BTS, 51Ω ± 5%	
R221	Composition, 160Ω ± 10% 1/4W	6099-1165	75042	BTS, 160Ω ± 10%	
R222	Composition, 3.6KΩ ± 5% 1/4W	6099-2365	75042	BTS, 3.6KΩ ± 5%	5905-577-0627
R223	Composition, 1.3KΩ ± 5% 1/4W	6099-2135	75042	BTS, 1.3KΩ ± 5%	5905-686-3119
R224	Film, 2KΩ ± 1% 1/8W	6250-1200	75042	CEA, 2KΩ	5905-577-6614
R225	Film, 2KΩ ± 1% 1/8W	6250-1200	75042	CEA, 2KΩ	5905-577-6614
R226	Composition, 360Ω ± 5% 1/4W	6099-1365	75042	BTS, 360Ω ± 5%	
R227	Composition, 13KΩ ± 5% 1/4W	6099-3135	75042	BTS, 13KΩ ± 5%	5905-702-4439
R230	Composition, 1.2KΩ ± 5% 1/4W	6099-2125	75042	BTS, 1.2KΩ ± 5%	
R231	Composition, 2.4KΩ ± 5% 1/4W	6099-2245	75042	BTS, 2.4KΩ ± 5%	5905-683-7724
R232	Composition, 1.2KΩ ± 5% 1/4W	6099-2125	75042	BTS, 1.2KΩ ± 5%	
R233	Composition, 3.6KΩ ± 5% 1/4W	6099-2365	75042	BTS, 3.6KΩ ± 5%	5905-577-0627
R234	Composition, 5.6KΩ ± 5% 1/4W	6099-2565	75042	BTS, 5.6KΩ ± 5%	5905-691-0195
R235	Pot, Comp., 500Ω ± 20%	6040-0300	01121	FWC, 500Ω ± 20%	5905-072-7795
R301	Composition, 4.3KΩ ± 5% 1/4W	6099-2435	75042	BTS, 4.3KΩ ± 5%	
R303	Composition, 3.3KΩ ± 5% 1/4W	6099-2335	75042	BTS, 3.3KΩ ± 5%	5905-681-9969
R304	Composition, 5.1KΩ ± 5% 1/4W	6099-2515	75042	BTS, 5.1KΩ ± 5%	5905-279-4623
R305	Composition, 150Ω ± 10% 1W	6110-1159	01121	GB, 1511	

†Denotes component only in units with ID Nos. ID-B100 and ID-B826.

Ref Desig.	Description	GR Part No.	Fed. Mfg. Code	Mfg. Part No.	Fed. Stock No.
RESISTORS (Cont'd)					
R306	Composition, 510Ω ± 5% 1/2W	6100-1515	01121	RC20GF511J	5905-279-3511
R307	Composition, 3.9KΩ ± 5% 1/4W	6099-2395	75042	BTS, 3.9KΩ ± 5%	
R308	Composition, 1KΩ ± 10% 1/4W	6099-2109	75042	BTS, 1KΩ ± 10%	
R401	Pot. Comp., 5KΩ ± 10%	Part of 6045-1107	01121	JJ, 5KΩ ± 10%	
R402	Composition, 51 Ω ±5% 2W	6120-0515	01121	RC42GF510J	5905-252-5425
R403	Pot., Comp., 5KΩ ± 20%	Part of 6045-1106	01121	JJ, 5KΩ ± 20%	
R406	Composition, 3.9Ω ± 5% 1/4W	6099-2395	75042	BTS, 3.9KΩ ± 5%	
R407	Composition, 100Ω ± 5% 1/2W	6100-1105	01121	RC20GF101J	5905-190-8889
R408	Composition, 180Ω ± 5% 1/2W	6100-1185	01121	RC20GF181J	5905-279-3514
R409	Composition, 100 Ω ± 5% 1/2W	6100-1105	01121	RC20GF101J	5905-190-8889
R410	Composition, 62Ω ± 5% 1/2W	6100-0625	01121	RC20GF620J	5905-279-1760
R411	Composition, 75Ω ± 5% 1/2W	6100-0755	01121	RC20GF750J	5905-279-1758
R412	Composition, 30Ω ± 5% 1/2W	6100-0305	01121	RC20GF300J	5905-279-3518
R413	Composition, 30Ω ± 5% 1/2W	6100-0305	01121	RC20GF300J	5905-279-3518
R416	Composition, 510Ω ± 5% 1/2W	6100-1515	01121	RC20GF511J	5905-279-3511
R417	Composition, 1KΩ ± 5% 1/4W	6099-2105	75042	BTS, 1KΩ± 5%	5905-681-6462
R418	Composition, 1.6KΩ ± 5% 1/4W	6099-2165	75042	BTS, 1.6KΩ ± 5%	
R419	Composition, 12KΩ ± 5% 1/4W	6099-3125	75042	BTS, 12KΩ ± 5%	
R420	Composition, 910Ω ± 5% 1/4W	6099-1915	75042	BTS, 910Ω ± 5%	
R421	Film, 909Ω ± 1% 1/4W	6350-0909	75042	CEB, 909Ω ± 1%	
R422	Composition, 10KΩ ± 5% 1/4W	6099-3105	75042	BTS, 10KΩ ± 5%	5905-683-2238
R423	Composition, 10Ω ± 10% 1/4W	6099-0109	75042	BTS, 10Ω ± 5%	
R502	Composition, 4.7KΩ ± 5% 1/4W	6099-2475	75042	BTS, 4.7KΩ ± 5%	
R503	Wire Wound, 1Ω ± 5% 2W	6760-9105	75042	BWH, 1Ω± 5%	
R504	Composition, 4.7KΩ ± 5% 1/4W	6099-2475	75042	BTS, 4.7KΩ ± 5%	
R505	Composition, 4.3KΩ ± 5% 1/4W	6099-2435	75042	BTS, 4.3KΩ ± 5%	
R506	Pot., Wire 1KΩ ± 10%	6056-0138	11236	Type 115, 1KΩ ± 10%	
R507	Composition, 2.2KΩ ± 5% 1/4W	6099-2225	75042	BTS 2.2KΩ ± 5%	
R508	Film, 2KΩ ± 1% 1/8W	6250-1200	75042	CEA, 2KΩ ± 1%	
R509	Film, 2.1KΩ ± 1% 1/8W	6250-1210	75042	CEA, 2.1KΩ ± 1%	
R510	Wire Wound, 1Ω ± 5% 2W	6760-9105	75042	BWH, 1Ω ± 5%	
R511	Composition, 390Ω ± 5% 1W	6110-1395	01121	RC32GF391J	5905-279-2642
R512	Composition, 4.7Ω ± 5% 1/2W	6100-9475	01121	EB, 4.7Ω ± 5%	
R513	Composition, 27Ω ± 5% 1/4W	6099-0275	75042	BTS, 27Ω ± 5%	
R514	Composition, 10KΩ ± 5% 1/4W	6099-3105	75042	BTS, 10KΩ ± 5%	5905-683-2238
R601	Pot., Comp., 5KΩ ± 10%	Part of 6045-1107	01121	JJ, 5KΩ ± 20%	
R602	Composition, 51Ω ± 5% 2W	6120-0515	01121	RC42GF510J	5905-252-5425
R603	Pot., Comp., 5KΩ ± 20%	Part of 6045-1106	01121	JJ, 5KΩ ± 20%	
R606	Composition, 180Ω ± 5% 1/2W	6100-1185	01121	RC20GF181J	5905-279-3514

Ref Desig.	Description	GR Part No.	Fed. Mfg. Code	Mfg. Part No.	Fed. Stock No.
RESISTORS (Cont'd)					
R607	Composition, 3.9KΩ ± 5% 1/4W	6099-2395	75042	BTS, 3.9KΩ ± 5%	
R608	Composition, 100Ω± 5% 1/2W	6100-1105	01121	RC20GF101J	5905-190-8889
R610	Composition, 75Ω ± 5% 1/2W	6100-0755	01121	RC20GF750J	5905-279-1758
R611	Composition, 75Ω ± 5% 1/2W	6100-0755	01121	RC20GF750J	5905-279-1758
R612	Composition, 75Ω ± 5% 1/2W	6100-0755	01121	RC20GF750J	5905-279-1758
R613	Composition, 30Ω ± 5% 1/2W	6100-0305	01121	RC20GF300J	5905-279-3518
R614	Composition, 30Ω± 5% 1/2W	6100-0305	01121	RC20GF300J	5905-279-3518
R615	Composition, 510Ω ± 5% 1/2W	6100-1515	01121	RC20GF5115	5905-279-3511
R616	Composition, 1.8KΩ ± 5% 1/4W	6099-2185	75042	BTS, 1.8KΩ ± 5%	
R617	Composition, 1KΩ ± 10% 1/4W	6099-2109	75042	BTS, 1KΩ± 10%	
R619	Composition, 10KΩ ± 5% 1/4W	6099-3105	75042	BTS, 10KΩ ± 5%	
R620	Film, 909Ω ± 1% 1/4W	6350-0909	75042	CEB, 1KΩ ± 1%	
R621	Composition, 16KΩ ± 5% 1/4W	6099-3165	75042	BTS, 16KΩ ± 5%	
R622	Composition, 1.1KΩ ± 5% 1/4W	6099-2115	75042	BTS, 1.1KΩ ± 5%	
R623	Composition, 10Ω ± 10% 1/4W	6099-0109	75042	BTS, 10Ω ± 10%	
SWITCHES					
S101	Pulse Period/Frequency	7890-5295	76854	Type F	
†S102	Single Pulse	7870-1120	81073	30-1 N.O.	
S102	Single Pulse	7870-1119	81073	30-2 N.C.	
S201	Pulse Duration	7890-5294	76854	269458-F2C	
S501	Power, ON-OFF	7910-1300	04009	83053-SA	5930-909-3510
S502	Line Voltage Selector	7910-0831	42190	4603	
S601	Source Selector	7910-0773	76854	#76	
TRANSFORMER					
T501	Power	0485-4038	24655	0485-4038	

†Denotes component only in units with ID Nos. ID-B100 and ID-B826.


NOTE UNLESS SPECIFIED
1. POSITION OF ROTARY SWITCHES SHOWN COUNTERCLOCKWISE.
2. CONTACT NUMBERING OF SWITCHES EXPLAINED ON SEPARATE SHEET SUPPLIED IN INSTRUCTION BOOK.
3. REFER TO SERVICE NOTES IN INSTRUCTION BOOK FOR VOLTAGES APPEARING ON DIAGRAM.
4. RESISTORS 1/2 WATT.
5. RESISTANCE IN OHMS K - 1000 OHMS M - 1 MEGOHM
6. CAPACITANCE VALUES ONE AND OVER IN PICOFARADS, LESS THAN ONE IN MICROFARADS.
7. KNOB CONTROL
8. SCREWDRIVER CONTROL
9. AT - ANCHOR TERMINAL
10. TP - TEST POINT
INDICATES FRONT PANEL ACCESS
INDICATES REAR PANEL ACCESS
(A-) INDICATES COMP ON CHASSIS
(B-) INDICATES COMP ON BOARD
-PULSE OFFSET
+20V
AT53
CW
AT55
A-R603 5K
AT54
-20V
CABLE WH-RD
AT46
B-R620 909 1/4W
AT45
OR
B-C609 .01
AT43
B-Q602
B-R610 75
FROM DURATION CKT (COLL B-Q208)
+0.7V
B-CR603
0
B-Q604
0 TO -5V
-6V
-1.15V
B-R606 180
-10V
-19V
B-Q606
-14.5V
B-C610 .01
B-R623 10 1/4W
B-C605 .01
B-R622 1.1K 1/4W
B-C604 .01
AT40
CCW
A-R601 5K
AT41
CW
AT42
B-R621 16K 1/4W
B-Q601
-6.2V
-1.2V
B-C611 4.7
B-R611 75
-6.2V
-1.1V
6.8V
-1.7V
B-Q603
-15V
-19.5V
B-Q608
B-R607 3.9K 1/4W
B-R608 100
B-R612 75
B-R613 30
-20V
-20V
-20VF
-20VF
-20VF
-PULSE AMPLITUDE
B-C606 15μF
B-C607 1μF
-20VF
-20V
B-L601 2.2μH
NEGATIVE - PULSE OUTPUT AMPLIFIER

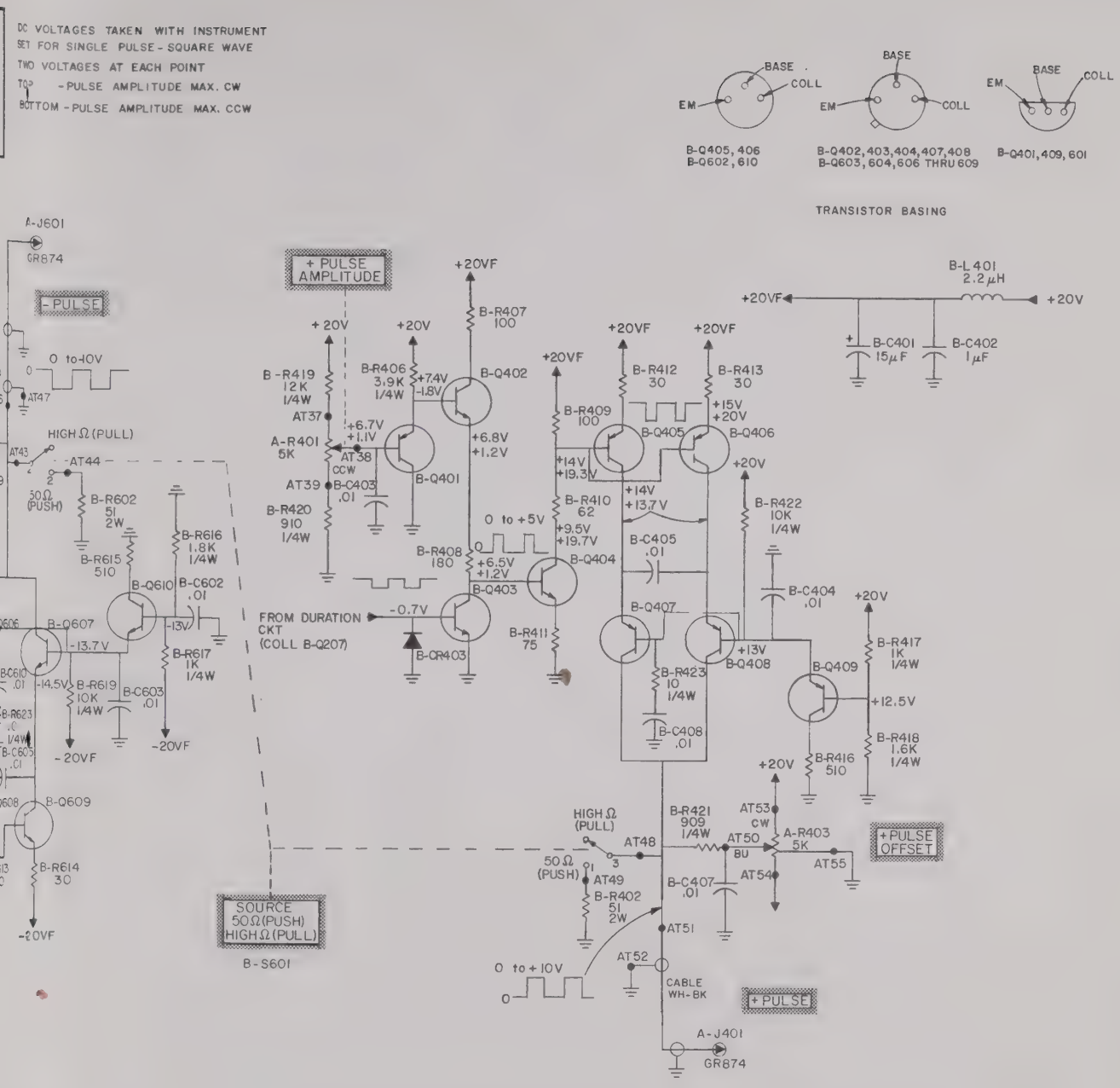


Figure 6-5. Schematic diagram of the output amplifiers.

GR874 COAXIAL COMPONENTS

GR874 CABLE CONNECTORS

APPLICABLE CABLE TYPES	CONNECTOR TYPE	CABLE	CABLE LOCKING	PANEL FLANGED	PANEL LOCKING	PANEL LOCKING RECESSED	PANEL LOCKING (KEYED)
	874-A2	-CA	-CLA	-PBA	-PLA	-PRLA	-PBRLA
50-OHM	RG-8A/U RG-9B/U RG-10A/U RG-87A/U RG-116/U RG-156/U RG-165/U RG-166/U RG-213/U RG-214/U RG-215/U RG-225/U RG-227/U	-C8A	-CL8A	-PB8A	-PL8A	-PRL8A	-PBRL8A
NON-50-OHM	RG-11A/U RG-12A/U RG-13A/U RG-63B/U RG-79B/U RG-89/U RG-144/U RG-146/U RG-149/U RG-216/U						
50-OHM	874-A3 RG-29/U RG-55/U (Series) RG-58/U (Series) RG-141A/U RG-142A/U RG-159/U RG-223/U	-C58A	-CL58A	-PB58A	-PL58A	-PRL58A	-PBRL58A
NON-50-OHM	RG-59/U RG-62/U (Series) RG-71B/U RG-140/U RG-210/U	-C62A	-CL62A	-PB62A	-PL62A	-PRL62A	-PBRL62A
50-OHM	RG-174/U RG-188/U RG-316/U	-C174A	-CL174A	-PB174A	-PL174A	-PRL174A	-PBRL174A
NON 50-OHM	RG-161/U RG-187/U RG-179/U						

Example. For a locking cable connector for RG-8A/U, order Type 874-CL8A.

GR874 ADAPTORS

TO TYPE		TYPE 874
APC-7		QAP7L*
BNC	plug	QBJA
		QBJL*
	jack	QBPA
C	plug	QCJA
		QCJL*
	jack	QCP
GR900		Q900L*
HN	plug	QHJA
	jack	QHPA
LC	plug	QLJA
		QLPA
LT	plug	QLPT
	jack	QLTJ
Microdot	plug	QMDJ
		QMDJL*
	jack	QMDP
N	plug	QNJA
		QNJL*
	jack	QNP
		QNPL*
OSM/BRM**	plug	QMMJ
		QMMJL*
	jack	QMMP
		QMMPL*
SC (Sandia)	plug	QSCJ
		QSCJL*
	jack	QSCP
TNC	plug	QTNJ
		QTNJL*
	jack	QTNP
UHF	plug	QUJ
		QUJL*
	jack	QUP
UHF 50-Ω Air Line	7/8-in. 1-3/8-in. 3-1/8-in.	QU1A QU2 QU3A

*Locking GR874 Connector

Example: To connect Type 874 to a type-N jack, order Type 874-QNP

**Reg. T.M. Omni Spectra, Inc.

OTHER COAXIAL ELEMENTS

TYPE 874	DESCRIPTION	TYPE 874	DESCRIPTION
A2	50-Ω cable (low loss)	MB	coupling mount
A3	50-Ω cable	MR, MRL, MRAL	mixer-rectifier
D20L, D50L	20-, 50-cm adjustable stubs	R20A, R20LA	patch cord, double shield
EL, EL-L	90° ell	R22A, R22LA	patch cord, double shield
F185L	185-MHz low-pass filter	R33, R34	patch cord, single shield
F500L	500-MHz low-pass filter	T, TL	tee
F1000L	1000-MHz low-pass filter	TPD, TPDL	power divider
F2000L	2000-MHz low-pass filter	U	U-line section
F4000L	4000-MHz low-pass filter	UBL	balun
IBL	bias insertion unit	VCL	variable capacitor
G3, G3L, G6, G6L G10, G10L, G14, G14L G20, G20L	3-, 6-, 10-, 14-, and 20-dB attenuators	VI	voltmeter indicator
		VQ, VQL	voltmeter detector
		VR, VRI	voltmeter rectifier
GAL	adjustable attenuator	W100	100-Ω termination
JR	rotary joint	W200	200-Ω termination
K, KL	coupling capacitor	W50B, W50BL	50-Ω termination
L10, L10L L20, L20L L30, L30L	10-, 20-, and 30-cm rigid air lines	WN, WN3, WNL	short-circuit terminations
		WO, WO3, WOL	open-circuit terminations
LAL	35-58 cm adjustable line	X	insertion unit
LK10L, LK20L	constant-Z adjustable lines	XL	series inductor
LR	radiating line	Y	cliplock
LTL	trombone constant-Z line	Z	stand
ML	component mount	-9508	air line inner conductor
		-9509	air line outer conductor

CONNECTOR ASSEMBLY TOOLS

TYPE 874	FUNCTION
TOK	Tool Kit
TO58	Crimping Tool
TO8	Crimping Tool

MISCELLANEOUS COAXIAL CONNECTORS

CONNECTOR TYPE	TYPE NO.	USED WITH
Basic	874-B	50-ohm air line
Basic Locking	874-BBL	50-ohm air line
Panel Locking	874-PLT	Wire lead
Panel Locking Recessed	874-PRLT	Wire lead
Panel Locking Feedthrough	874-PFL	Type 874 patch cords

L suffix indicates locking Type 874 Connector

FOR COMPLETE DETAILS, REFER TO THE GENERAL RADIO CATALOG.

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NOTE UNLESS SPECIFIED

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2. CONTACT NUMBERING OF SWITCHES EXPLAINED ON SEPARATE SHEET SUPPLIED IN INSTRUCTION BOOK.
3. REFER TO SERVICE NOTES IN INSTRUCTION BOOK FOR VOLTAGES APPEARING ON DIAGRAM.
4. RESISTORS 1/4 WATT.
5. RESISTANCE IN OHMS K = 1000 OHMS M = 1 MEGOHM
6. CAPACITANCE VALUES ONE AND OVER IN PICOFARADS. LESS THAN ONE IN MICROFARADS.
7. ◯ KNOB CONTROL
8. ⊘ SCREWDRIVER CONTROL
9. AT - ANCHOR TERMINAL
10. TP - TEST POINT

INDICATES FRONT PANEL ACCESS

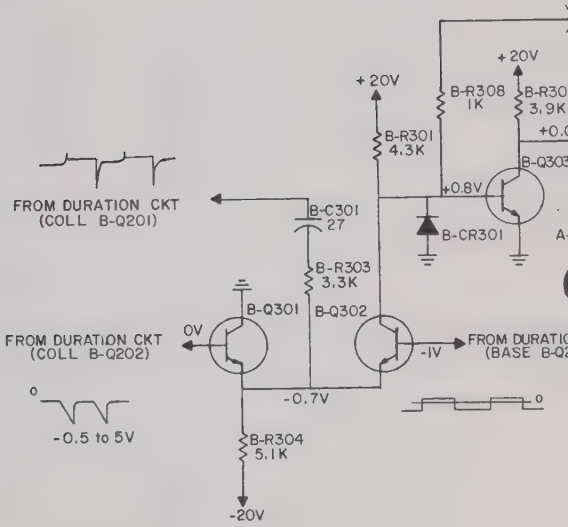
INDICATES REAR PANEL ACCESS

(A-) INDICATES COMP ON CHASSIS

(B-) INDICATES COMP ON ETCHED BOARD

(V-) INDICATES COMP ON TRANSFORMER SUB-ASSEMBLY

WAVEFORMS SHOWN ARE IDEALIZED WAVEFORMS



DUTY-RATIO OVERREACH DETECTOR

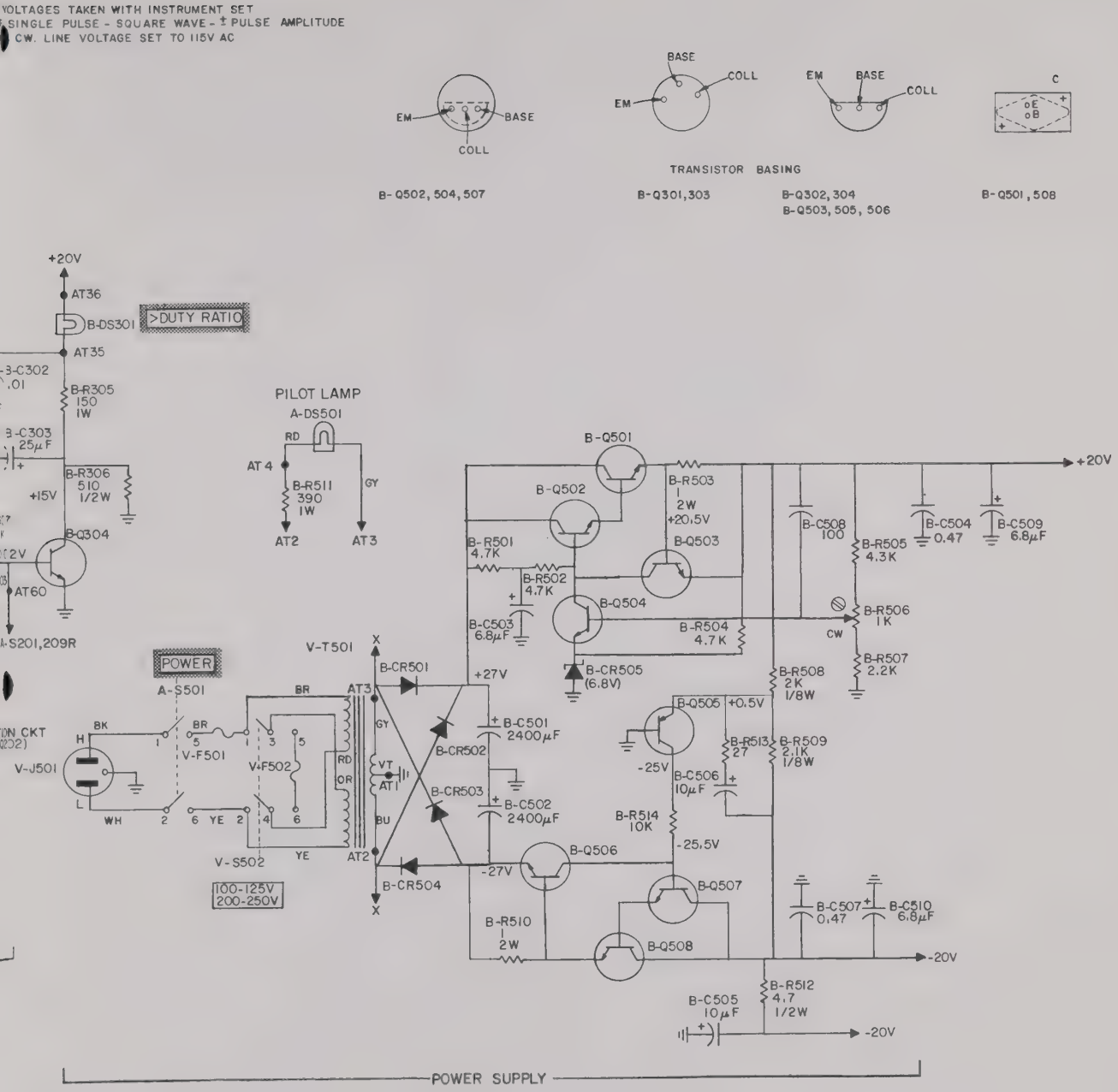


Figure 6-6. Duty-ratio overreach detector and power supply schematic.

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